FIFTY YEARS OF PROGRESS ON DOMINION EXPERIMENTAL FARMS

1886 - 1936

FIFTY YEARS

OF

PROGRESS

ON

DOMINION

EXPERIMENTAL

FARMS

1886 - 1936

The William Saunders memorial building which houses the present administration service for the Experimental Farms. This building was formally opened in June, 1936, on the fiftieth anniversary of the founding of the Experimental Farms System.

Fifty Years of Progress

on

Dominion Experimental Farms

1886 - 1936

OTTAWA
J. O. Patenaude, I.S.O.
Printer to the King's Most Excellent Majesty
1939

THE HONOURABLE J. G. GARDINER
MINISTER OF AGRICULTURE

FOREWORD

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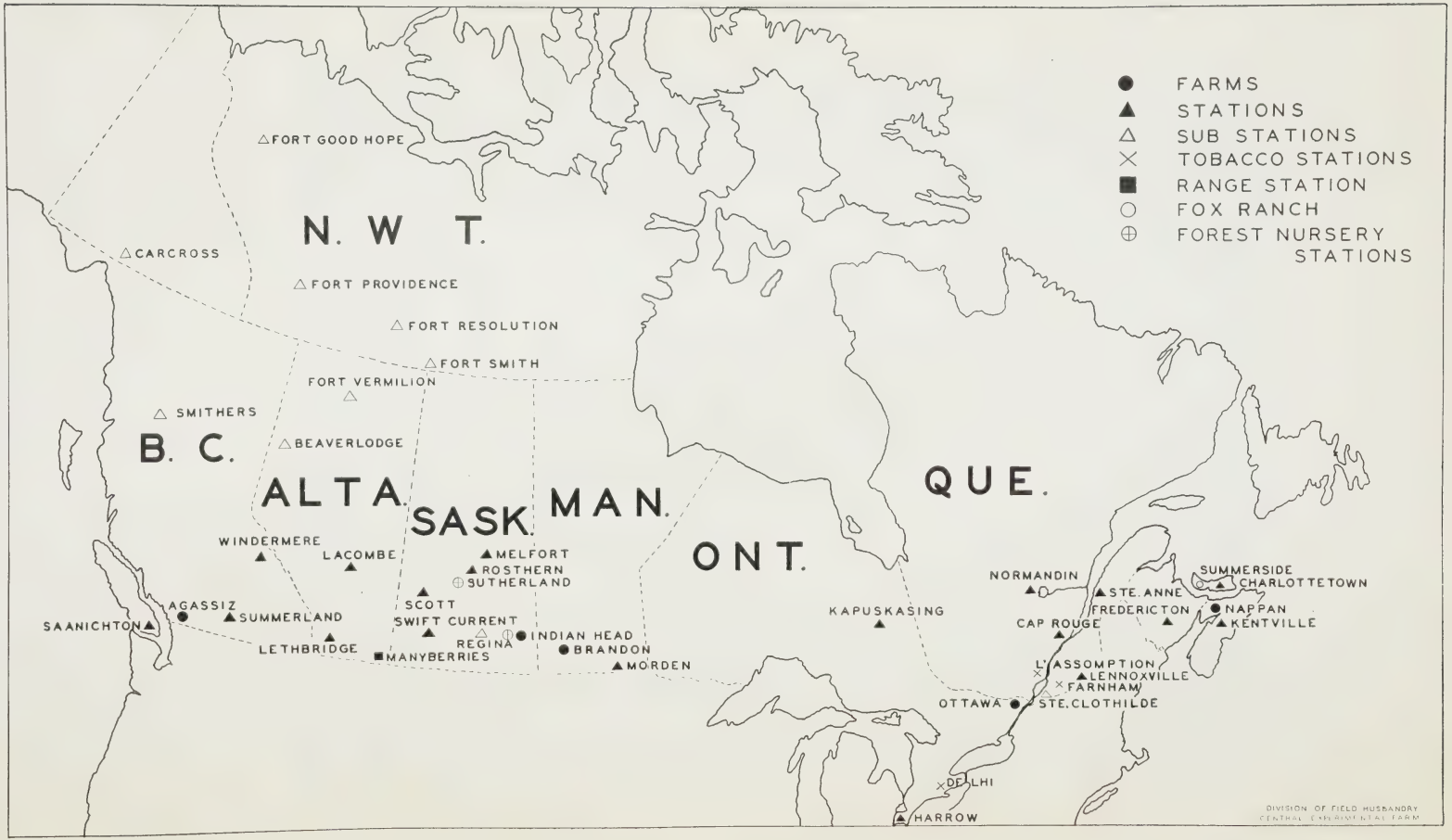
THE publication of this record of Fifty Years of Progress of the Dominion Experimental Farms is particularly appropriate at this time, since the Dominion Department of Agriculture is now being reorganized. This in turn affects the Experimental Farms Service as to the divisions contained therein and their relationship to the other services in the department.

The history of an institution is essentially the history of its accomplishments and personnel. A brief sketch of the senior personnel is given in the historical section of the publication while the balance is devoted to a very brief outline of the accomplishments and present activities which will have undoubted value in the upbuilding of Canadian agriculture.

Farming is a complicated business. Many of the problems connected with it are as old as agriculture itself and new problems are arising constantly. Today, more than ever before, progress and success in farming depend very largely upon the facts as discovered by science, and the application of these facts to the problems confronting the farmers. Every member of the staff has the interest of agriculture at heart and welcomes the opportunity to serve when the service comes within the scope of activities for which the Dominion Experimental Farms were established. The greatest good can only be accomplished if the farmers of the country make the fullest possible use of the information and services which are available to them.


FARMS
STATIONS
SUB STATIONS
TOBACCO STATIONS
RANGE STATION
FOX RANCH
FOREST NURSERY STATIONS
FORT GOOD HOPE
N. W T.
CARCROSS
FORT PROVIDENCE
FORT RESOLUTION
FORT SMITH
FORT VERMILION
SMITHERS
B. C.
BEAVERLODGE
ALTA.
SASK.
MAN.
ONT.
QUE.
WINDERMERE
LACOMBE
MELFORT
ROSTHERN
SUTHERLAND
AGASSIZ
SUMMERLAND
SAANICHTON
SCOTT
SWIFT CURRENT
REGINA
INDIAN HEAD
BRANDON
MORDEN
LETHBRIDGE
MANYBERRIES
KAPUSKASING
NORMANDIN
STE. ANNE
SUMMERSIDE
CHARLOTTETOWN
FREDERICTON
NAPPAN
CAP ROUGE
KENTVILLE
L'ASSOMPTION
LENNOXVILLE
FARNHAM
OTTAWA
STE. CLOTHILDE
DELHI
HARROW
DIVISION OF FIELD HUSBANDRY
CENTRAL EXPERIMENTAL FARM

LIST OF PAST AND PRESENT DIRECTORS, CHIEF OFFICERS OF DIVISIONS AND SUPERINTENDENTS OF BRANCH FARMS AND STATIONS

Directors—

Wm. Saunders, C.M.G., LL.D.	1886–1911
J. H. Grisdale, B.Agr., D.Sc.	1911–1919
E. S. Archibald, B.A., B.S.A., LL.D., D.Sc.	1919

Assistant Director—

Frank T. Shutt, M.A., D.Sc.	1912–1933

Agriculturists—

(Acting) Wm. Saunders, C.M.G., LL.D.	1887–1890
Jas. W. Robertson, LL.D.	1890–1896
(Acting) Wm. Saunders, C.M.G., LL.D.	1897–1898
J. H. Grisdale, B.Agr., D.Sc.	1899–1911
(Acting) J. H. Grisdale, B.Agr., D.Sc.	1911–1912

Animal Husbandmen—

E. S. Archibald, B.A., B.S.A., LL.D., D.Sc.	1912–1919
G. B. Rothwell, B.S.A.	1919–1931
(Acting) G. W. Muir, B.S.A.	1931–1933
G. W. Muir, B.S.A.	1933

Field Husbandmen—

(Acting) J. H. Grisdale, B.Agr., D.Sc.	1912–1919
(Acting) E. S. Archibald, B.A., B.S.A., LL.D., D.Sc.	1919–1920
E. S. Hopkins, B.S.A., M.S., Ph.D.	1920

Horticulturists—

W. W. Hilborn	1887–1889
John Craig	1890–1897
W. T. Macoun, D.Sc.	1898–1933
M. B. Davis, B.S.A., M.Sc.	1933

Poultry Husbandmen—

A. G. Gilbert	1888–1913
F. C. Elford	1913–1937
(Acting) G. Robertson	1937

Cerealists—

(Acting) Wm. Saunders, C.M.G., LL.D.,	1887–1902
C. E. Saunders, Ph.D. (termed Experimentalist, 1903–1904)	1903–1922
L. H. Newman, B.S.A., D.Sc.	1923

Agrostologists—

M. O. Malte, Ph.D.	1912–1921
G. P. McRostie, B.S.A., Ph.D.	1922–1930
L. E. Kirk, Ph.D.	1931

Chief, Fibre Division—

G. G. Bramhill, B.S.A.	1917–1918
R. J. Hutchinson	1918

Apiarists—

F. W. L. Sladen	1914–1921
C. B. Gooderham, B.S.A.	1921

Tobacco Husbandmen—

F. Charlan	1913–1924
C. M. Slagg, B.S., M.S.	1924–1928
N. T. Nelson, Ph.D.	1928

Chemists—
Frank T. Shutt, M.A., F.I.C., D.Sc. 1887–1933
(Acting) C. H. Robinson, B.A. 1933–1935
C. H. Robinson, B.A. 1935

Botanist—
H. T. Güssow, F.L.S., F.R.M.S., LL.D. 1909

Agricultural Bacteriologist—
A. G. Lochhead, Ph.D. 1923

Chief Supervisors, Illustration Stations—
John Fixter 1915–1927
J. C. Moynan, B.S.A. 1928

Chiefs, Extension and Publicity—
J. F. Watson 1914–1917
W. A. Lang 1917–1921
F. C. Nunnick, B.S.A. 1921–1935

Farm Foremen—
John Fixter 1887–1906
D. D. Gray 1906–1918

Farm Superintendent—
D. D. Gray 1918

SUPERINTENDENTS OF BRANCH FARMS AND STATIONS

Experimental Station, Charlottetown, P.E.I.—
J. A. Clark. B.S.A., M.S.A., D.Sc 1909

Experimental Fox Ranch, Summerside, P.E.I.—
G. E. Smith, B.A.Sc. 1925

Experimental Station, Kentville, N.S.—
W. Saxby Blair, D.Sc. 1912

Experimental Farm, Nappan, N.S.—
Wm. M. Blair 1887–1896
Geo. W. Forrest 1896–1897
R. Robertson 1898–1913
W. W. Baird, B.S.A. 1913

Experimental Station, Fredericton, N.B.—
W. W. Hubbard 1912–1922
C. F. Bailey, B.S.A. 1922

Experimental Station, Ste. Anne de la Pocatière, Que.—
Jos. Bégin 1912–1921
J. A. Ste. Marie, B.S.A. 1921

Experimental Horse Farm, St. Joachim, Que. 1920

Experimental Station, Farnham, Que.—
O. Chevalier 1912–1916
J. E. Montreuil, B.S.A. 1919–1928
R. Bordeleau, B.S.A. 1929

Experimental Station, Cap Rouge, Que.—
G. A. Langelier, D.Sc.A. 1911–1933
(Acting) C. E. Ste. Marie, B.S.A. 1933–1936
C. E. Ste. Marie, B.S.A. 1936

Experimental Station, Lennoxville, Que.—

J. A. McClary	1914–1937
(Acting) F. S. Browne, B.S.A.	1937

Experimental Station, L'Assomption, Que.—

J. E. Montreuil, B.S.A.	1928

Experimental Station, La Ferme, Que.—

Pascal Fortier, Agr.	1916–1932
(Acting) J. C. H. Chabot, B.S., B.S.A.	1932–1936

Experimental Station, Normandin, Que.—

J. A. Belzile, B.S.A.	1936

Experimental Station, Kapuskasing, Ont.—

S. Ballantyne	1916

Experimental Station, Harrow, Ont.—

W. A. Barnet	1908–1915
D. D. Digges, M.S.A.	1915–1926
H. A. Freeman, B.S.A., M.Sc.	1926–1928
H. F. Murwin, B.S.A.	1929

Experimental Station, Morden, Man.—

E. M. Straight, B.S.A.	1918–1921
W. R. Leslie, B.S.A.	1921

Experimental Farm, Brandon, Man.—

S. A. Bedford	1888–1905
N. Wolverton, B.A.	1906–1907
Jas. Murray, B.S.A.	1907–1911
W. C. McKillican, B.S.A.	1911–1925
M. J. Tinline, B.S.A.	1925

Experimental Farm, Indian Head, Sask.—

Angus Mackay	1888–1913
T. J. Harrison, B.S.A.	1913–1915
W. H. Gibson, B.S.A.	1915–1919
N. D. MacKenzie, B.S.A.	1919–1924
W. H. Gibson, B.S.A.	1924

Forest Nursery Station, Indian Head, Sask.—

N. M. Ross, B.S.A., B.F., (Transferred from Department of Interior to Department of Agriculture)	1931

Forest Nursery Station, Sutherland, Sask.—

Jas. McLean (Transferred from Department of the Interior to Department of Agriculture)	1931

Experimental Station, Rosthern, Sask.—

W. A. Munro, B.A., B.S.A.	1909–1932
(Acting) F. V. Hutton, B.S.A.	1932–1935
F. V. Hutton, B.S.A.	1935

Experimental Station, Scott, Sask.—

R. E. Everest, B.S.A.	1911–1914
M. J. Tinline, B.S.A.	1914–1924
V. Matthews, B.S.A.	1924–1928
G. D. Matthews, B.S.A.	1928

Experimental Station, Swift Current, Sask.—

J. G. Taggart, B.S.A.	1921–1934
L. B. Thomson, B.Sc.	1935

Experimental Station, Melfort, Sask.—

M. J. McPhail, B.S.A.	1935

Experimental Station, Lethbridge, Alta.—
W. H. Fairfield, M.S., LL.D. 1906

Experimental Station, Lacombe, Alta.—
G. H. Hutton, B.S.A. 1907–1919
F. H. Reed, B.S.A. 1920

Experimental Station, Summerland, B.C.—
R. H. Helmer 1914–1923
W. T. Hunter 1923–1931
R. C. Palmer, B.S.A., M.S.A. 1932

Experimental Farm, Agassiz, B.C.—
Thos. A. Sharpe 1888–1911
P. H. Moore, B.S.A. 1911–1916
W. H. Hicks, B.S.A. 1916

Experimental Station, Windermere, B.C.—
G. E. Parham 1913–1919
R. G. Newton, B.S.A. 1919

Experimental Station, Saanichton, B.C.—
L. Stevenson, M.S. 1915–1921
E. M. Straight, B.S.A. 1921

Experimental Sub-Station, Fort Vermilion, Alta.—
Robert Jones 1908–1933
(Acting) A. Lawrence 1933

Experimental Sub-Station, Beaverlodge, Alta.—
W. D. Albright 1915

Dominion Range Experiment Station, Manyberries, Alta.—
L. B. Thomson, B.Sc. 1927–1935
(Acting) H. J. Hargrave, B.S.A. 1935

OFFICERS-IN-CHARGE BRANCH LABORATORIES

Laboratory of Plant Pathology, Charlottetown, P.E.I.—
P. A. Murphy, M.A., Ph.D. 1915–1920
J. B. MacCurry, B.S.A. 1921–1926
R. R. Hurst, B.S.A. 1926

Laboratory of Plant Pathology, Kentville, N.S.—
J. F. Hockey, B.S.A. 1923

Laboratory of Plant Pathology, Fredericton, N.B.—
G. C. Cunningham, B.S.A. 1915–1923
D. J. MacLeod, B.A., M.A. 1924

Laboratory of Plant Pathology, Ste. Anne de la Pocatière, Que.—
H. N. Racicot, B.A. 1923–1930
C. Perrault, M.Sc. 1930

Laboratory of Plant Pathology, St. Catharines, Ont.—
W. A. McCubbin, M.A. 1912–1919
W. H. Rankin, Ph.D. 1919–1922
G. H. Berkeley, Ph.D. 1923

Rust Research Laboratory, Winnipeg, Man.—
(Botany) D. L. Bailey, Ph.D. 1925–1928
J. H. Craigie, Ph.D. 1928

(Cereal) C. H. Goulden, Ph.D. 1925

Laboratory of Plant Pathology, Saskatoon, Sask.—
W. P. Fraser, M.A. 1916–1925
G. B. Sanford, Ph.D. 1925–1926
P. M. Simmonds, Ph.D. 1927

Dominion Forage Crop Laboratory, Saskatoon, Sask.—
T. Stevenson, M.S.A. 1932

Laboratory of Plant Pathology, Edmonton, Alta.—
G. B. Sanford, Ph.D. 1926

Laboratory of Plant Pathology, Summerland, B.C.—
H. R. McLarty, Ph.D. 1921

Laboratory of Plant Pathology, Saanichton, B.C.—
Wm. Newton, Ph.D. 1928

SUB-STATIONS

Experimental Sub-Station, Delhi, Ont. 1933

Experimental Sub-Station, Ste. Clothilde, Que.—
F. S. Browne, B.S.A. 1936

Experimental Sub-Station, Regina, Sask. 1931

Experimental Sub-Station, Rosthern, Sask.—
S. E. J. Wheeler 1931

Cattalo Enclosure, Buffalo Park, Wainwright, Alta.—
A. G. Smith 1922

Experimental Sub-Station, Kelowna, B.C. 1931

Experimental Sub-Station, Kamloops, B.C. 1935

Experimental Sub-Station, Milner, B.C. 1932

MINOR SUB-STATIONS

Experimental Sub-Station, Harrington Harbour, Gaspé, Que. 1932

Experimental Sub-Station, Fort Smith, N.W.T. 1911

Experimental Sub-Station, Fort Resolution, N.W.T. 1911

Experimental Sub-Station, Fort Providence, N.W.T. 1911

Experimental Sub-Station, Fort Good Hope, N.W.T. 1928

Experimental Sub-Station, Carcross, Yukon 1936

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FIFTY YEARS OF PROGRESS ON DOMINION EXPERIMENTAL FARMS

Historical

THE Dominion Experimental Farms System was inaugurated in 1886. The fiftieth anniversary was celebrated on June 6, 1936, by the official opening of a new administration building, called the "William Saunders Building," erected on the site of the residence of the first Director, Dr. William Saunders. At the same time the Macoun Memorial Garden was opened on the site of the residence of Dr. W. T. Macoun, one of Dr. Saunders' first co-workers.

Coincident half-century celebrations of rather direct interest to Canadians occurred in other countries. Australia observed in 1936 the fiftieth anniversary of the beginning of the work of that remarkable man, Farrar, who left the University at Oxford to become Australia's foremost wheat breeder. Sweden held a special convocation to commemorate the half-century anniversary of the establishment of the world-famous plant-breeding institution at Svalof. Denmark dates from 1886 the foundation upon which was built the modern plant-breeding organization of that country.

The first 50 years of the Dominion Experimental Farms have been rich in accomplishment for Canadian agriculture. It is fitting to commemorate the Golden Jubilee by briefly recalling the history, explaining the organization and reviewing a few of the major achievements.

The personnel has grown to number some 1,400 employees; operations extend from the Atlantic to the Pacific, from the International boundary almost to the Arctic Circle. Marquis wheat alone has long since repaid the cost of the organization yet this is but one of many hundred important contributions.

Inception Of The System

Credit for the inception of the system goes largely to two men from London, Ont., Hon. (afterwards Sir) John Carling, Minister of Agriculture, and Prof. (afterwards Dr.) Wm. Saunders, the first Director.

In 1884 Canada was facing the need of recasting her agriculture. In the East primitive methods no longer sufficed. The nascent West was presenting fresh problems of its own. Thinkers discerned that Canada's future as a nation depended upon a contented and prosperous people; that such contentment and prosperity were impossible unless agriculture were put upon a permanent, profitable footing; that farming, while the most important industry of the country, was also a mode of living, and hence everything tending to a wider and fuller life on the farm was deserving of the most careful attention.

In January of that year a Select Committee of the House of Commons, headed by G. A. Gigault, Member of Parliament for Rouville, Que., and known as the Gigault Committee, was appointed to investigate the need for agricultural improvement. After holding meetings, sending out questionnaires and calling witnesses, this committee presented a valuable report suggesting the establishment of a Bureau of Agriculture and an Experimental Farm in connection therewith.

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Examples From Europe

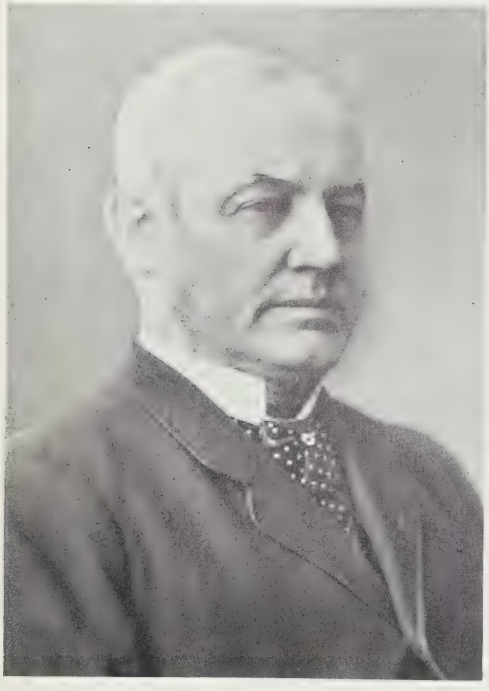
Institutions for agricultural service were already in existence. One at Rothamsted, England, called the "Mother of Experimental Stations," had been founded by Sir John B. Lawes as a private enterprise. Field experiments commenced there in 1843.

In Germany, according to Prof. P. D. Penhallow, Botanist of McGill University, giving evidence before the Gigault Committee, experimental farms began in Saxony in 1852 through the banding together of farmers to have plants and animals tested on a particular farm at less expense of time and money than by individual trial. They engaged a manager and when the work grew extensive asked for government aid. The German Government investigated, approved and furnished aid not only for that enterprise but for others of a like nature. Within 30 years there were more than 80 German stations, nearly all of them more or less supported by government funds. France investigated the German system, reported favourably, and by 1878 had established 43 subsidized stations of her own. In 1882 *Le Journal d'Agriculture Pratique*, of France, thus commented upon the French stations:—

> "Their usefulness can no longer be disputed. The farmers can no more dispense with them than we can dispense with the services of a physician in cases of sickness or men of law in litigious matters."

The United States had a system of land-grant agricultural colleges (some with experiment stations), established under the Morrill Act passed in 1862, though the Hatch Act, providing specifically for land grants to a system of state experiment stations, was not passed until 1887. Several states had acted before the passing of the Morrill Act, Michigan having the oldest agricultural college, dating from 1857.

An institution built at Cirencester, England, in 1845, was in 1880 named by Her Majesty, Queen Victoria, "The Royal Agricultural College." The Downton Agricultural College, near Salisbury, was established in 1880.



Sir John Carling

Beginnings in Canada

In Canada a school of agriculture, now affiliated with the faculty of Arts of Laval University, was established at Ste. Anne de la Pocatière in 1859. Experimental work was carried on in connection with the Ontario Agricultural College, founded in 1873. Prince Edward Island had a government stock farm.

Among many persons giving evidence to the Gigault Committee was Prof. Wm. Brown of the Ontario Agricultural College, who pleaded for an annual government report that would be "crisp, semi-entertaining, partly historical, up-to-time, and smart in its issue."

From the report of the Dominion Minister of Agriculture in 1886 it is noted that $20,000 was placed in the estimates for work in connection with an experimental farm.

Early Appointments

In 1884 Mr. James Fletcher, of the Parliamentary Library, was appointed Honorary Entomologist. He was placed on a salaried basis on July 1, 1887.

On November 2, 1885, Wm. Saunders was appointed to investigate further, with particular reference to the experiment stations of the United States. His masterly report, dated February 20, 1886, recorded fully what was being done there; also, more cursorily, what had been done elsewhere throughout the world; made note of forestry work and botanic gardens established in various countries and recommended that work be undertaken in Canada. The report was presented to the House of Commons by Hon. Mr. Carling on April 15, 1886, and a bill bearing the title, "An Act Respecting Experimental Farm Stations" passed its third reading May 12. On June 2 it received the Royal Assent. This Act authorized the establishment of five farm stations, the one for Ontario and Quebec to be the principal or central station. A sub-section authorized the setting aside of land in the West for forestry and tree-planting purposes.

The original tree of the hardy apple, Pyrus baccata, raised from seed imported from Russia and used in much of the early work in connection with the breeding of hardy apples for the Canadian Prairies.

Development During The First Directorship, 1886-1911

The land finally chosen for the Central Experimental Farm comprised 466 acres just outside the city boundary of the Capital. It was an assortment of properties, some in rough condition. There were many large pine stumps on the fields and the division fences were well packed with stones. The early appointment of an entomologist was ironically appropriate for as late as 1888, members of the Ottawa Field-Naturalists' Club visiting the farm were "forced to flee from the mosquitoes emerging from a large swamp on the property".

Dr. Saunders was appointed Director on October 12, 1886, but title to the property was not obtained until November, so that only a little ploughing

and clearing could be done that fall. Building continued throughout the winter, and during the next two years the property was transformed by clearing, levelling, draining, fencing and roadmaking. Meanwhile the Director was busy selecting the branch farms at Nappan, N.S., Brandon, Man., Indian Head, Sask., and Agassiz, B.C. He was very thorough, his policy being to visit a site at three different seasons before reporting upon its suitability.

An arboretum and botanic garden was laid out at the Central Farm, the erection of buildings was put well under way and experimental work was commenced. Wheat was imported from a high latitude in Russia. Seeds and trees from many parts of the world were ordered for planting.

Frank T. Shutt was appointed Chemist on July 18, 1887. Horticulture was first entrusted to W. W. Hilborn, succeeded by John Craig, and he by the late W. T. Macoun. Poultry work commenced almost from the beginning. Dr. Saunders, in addition to his administrative duties, assumed charge of agriculture, covering field and live stock work as well as experimental work with cereals. Expansion finally demanded the appointment of special officers to supervise these different lines of investigation but during his whole career as Director, Dr. Saunders continued to take the keenest interest in his favourite avocation of plant breeding. From 1890 to 1896 Jas. W. Robertson was Agriculturist. He was followed some two or three years later by J. H. Grisdale, B.Agr.

More Branch Farms Needed

Early in the present century the need of further branch stations became evident. The West was being settled rapidly. The effect of variations in soil and climate were becoming better understood. Good results had been obtained from the five farms originally established. These were by the Act establishing them called "farms". The newer ones were designated "stations"—a distinction without a difference. In 1906 a station was created a Lethbridge, Alta., in the irrigation belt; in 1907 one was organized at Lacombe, in the mixed-farming region in what was regarded as northern Alberta but which is really considerably south of the centre.

In 1908 a little work was begun on a leasehold basis on the farm of Robert Jones at Fort Vermilion, Alta. (Lat. 58° 22′ N.). This ranked as a sub-station. It followed an earlier start by Fred Lawrence at the same point.

Following the death of Dr. Fletcher, the dual Division of Botany and Entomology was divided in 1909 and two new appointments were made. Chas. Gordon Hewitt became Entomologist and Hans T. Güssow, Botanist.

The stations at Rosthern, Sask., and Charlottetown, P.E.I., date from 1909; Cap Rouge, Que., and Scott., Sask., from 1911.

An important change in supervision became necessary in 1910. Until then the Director had personally supervised and inspected all work on the branch farms. Thenceforth the chiefs of the various divisions at headquarters were given supervision, under the Director's general control, of their respective lines of investigation on the branch farms and stations. Indicating their wider responsibilities, the word "Dominion" was prefixed to their titles. In 1911 owing to age and ill health Dr. Wm. Saunders retired from a life of high and strenuous service, to be succeeded by the Agriculturist, J. H. Grisdale.

Development During the Second Directorship, 1911-1919

To the second Director fell the heavy task of getting full lines of work under way at the newer stations so rapidly organized during the past few years. His was not only an era of expansion but it coincided with what may be called the period of transition between the older and the newer, the primary and the secondary, the basic and the more complex systems of agricultural investigation. The work of the divisions was revised and broadened. New ones were created,

such as Agrostology, Fibre Plants, Illustration Stations, Extension and Publicity, and Bees. Agriculture was divided into Animal Husbandry and Field Husbandry. This reorganization led to the appointment of several chief technical officers and assistants, with specialized training and duties.

In 1912 by way of further reconnoitering the possibilities of the frontier, five more sub-stations were established, one in the hands of S. J. Webb, in the Grande Prairie District of the Upper Peace River region. By a coincidence, Mr. Webb's post office was then known as Beaverlodge, afterwards Lake Saskatoon. Upon his leaving the district for service overseas, the duties were in 1915 turned over to the present incumbent at the present town of Beaverlodge. A limited amount of work was arranged for with the Roman Catholic Missions at Girouard, Alta., on Lesser Slave Lake and at Forts Smith, Resolution and Providence, all in the Northwest Territories.

The former administration building at Ottawa. The centre portion was the original structure.

In 1912 the Tobacco Division, formerly a separate branch of the Department of Agriculture, was made part of the Experimental Farms Branch. In the same year the experimental stations at Ste. Anne de la Pocatière, Que., Kentville, N.S., Fredericton, N.B., Invermere, B.C., and Sidney, B.C., were established.

The poultry department was made a division in 1913.

Early in 1914 work began on two new stations, at Lennoxville, Que., and Summerland, B.C. In 1914 the Division of Entomology was constituted a separate branch of the Department of Agriculture.

The Great War breaking out later in that year and drawing many volunteers from the staff, postponed many features of the expansion policy. The experimental farms, moreover, were called upon to play a leading part in stimulating and guiding immediate maximum production. Even under these adverse conditions some progress was made. A station intended to specialize on prairie horticulture was established at Morden, Man., in 1915; a general one at La

Ferme, northern Quebec, in the same year and one at Kapuskasing, in the clay belt of northern Ontario, in 1914.

As a means of carrying the salient findings of the experimental farms into the local communities a system of illustration stations was established in 1915.

In 1919 Dr. Grisdale was appointed by the Hon. T. A. Crerar, then Minister of Agriculture, to the post of Deputy Minister of the department and was succeeded by E. S. Archibald.

Development During the Third Directorship, 1919

The policy of expansion was continued under Dr. Archibald's directorship despite the drawbacks of war and post-war conditions. Effort was more particularly directed, however, toward systematic, intensive investigation carried through to the point of specialized assistants upon the branch farms and stations. Stress was placed upon scientific precision, in accord with the spirit of modern requirements. Botanical laboratories were established at branch farms and elsewhere.

In 1920 an additional station was located at Swift Current, in southwestern Saskatchewan. A farm devoted especially to the breeding of French-Canadian horses was established at St. Joachim, Que. In 1923 the tobacco station at Harrow, Ont., was expanded into a regular station. At the Central Farm the Division of Agricultural Bacteriology was formed and the work of other divisions was widened, the Poultry Division taking on egg-contest work while the Division of Botany undertook plant-pathological and potato-inspection services. The range experiment station at Manyberries, Alta., dates from 1926. In 1928 a new minor sub-station was established at Fort Good Hope near the Arctic Circle. In the same year a station was established at L'Assomption, Que.

In 1931 a sub-station was established at Regina on 230 acres of land leased from the Saskatchewan Government, and later that year a forage plants laboratory was established at Saskatoon in co-operation with the University of Saskatchewan.

In 1931 the Experimental Farms Branch co-operated with the Health of Animals Branch in establishing at Milner, B.C., a station for the study of the redwater disease of cattle. In 1931 the forest nursery stations of the Tree-planting Division of the Department of Interior were turned over to the Experimental Farms Branch.

The next year 50 acres were leased at Delhi, Ont., for tobacco work.

More New Activities

In 1935 a new station was opened at Melfort, in northern Saskatchewan, to serve a distinct territory. That year, also, 80 arpents of land was purchased at Ste. Clothilde, near Montreal, for a sub-station on which to make an intensive study of truck-crop production on black-muck soils. In October, 1935, a tract of 200 acres was purchased at Normandin, in the Lake St. John District of northern Quebec, to supersede the station at La Ferme, which was in a non-agricultural district and was closed out in 1936.

In the Yukon Territory a very little sub-station work had once been conducted with surprising results at Swede Creek. This was followed by work at Carmacks, 1932 to 1935, and later at Carcross in 1936.

Minor phases of work include a supervision of buffalo-breeding experiments at Wainwright Park.

More than 1,700 main experimental projects are under way throughout the system, most of these comprising a number of sub-projects, some of which in themselves amount to fairly wide experiments.

The direction of this far-flung system with its wide diversity of conditions makes heavy demands upon executive ability, and calls for organization and

specialization in ever-growing degree. On nearly every hand the work has passed the rudimentary stage, much of it taking on the character of research. The science divisions, besides carrying many projects of their own, stand ready to assist the crop and live stock workers. The Division of Botany has ten branch laboratories across the Dominion mostly associated with other institutions. The Division of Forage Plants has one branch laboratory.

In 1935 the Director was charged with the responsibility of administering the Prairie Farm Rehabilitation Act program.

Visit of the members of parliament to the Central Experimental Farm in 1890.

The Present Organization*

At the Central Experimental Farm are located the office of the Director, as general administrator, and 13 divisions, each under the control and supervision of a divisional chief. The divisions are: Animal Husbandry, Bacteriology, Bee, Botany, Cereal, Chemistry, Fibre, Field Husbandry, Forage Plants, Horticulture, Illustration Stations, Poultry, and Tobacco.

In these divisions is centered the preliminary work of research and experiment, the more practical aspects of which are extended to the 30 branch farms and stations. Included in this count are the two forest nursery stations propagating trees for prairie distribution, a fox ranch, and two range experiment stations. In addition there are 16 sub-stations and a horse breeding station. Then there are 43 district experiment sub-stations under the Prairie Farm Rehabilitation program.

The Dominion Experimental Farms System may be loosely compared to the hub and spokes of a wheel. The hub is the headquarters at the Central

*In the reorganization of the Department, the Divisions of Bacteriology, Botany and Chemistry, which up to the present have formed part of the Experimental Farms Service, will be transferred to the newly established Science Service of the Dominion Department of Agriculture, effective April 1, 1937. They will, however, continue to be located at the Central Experimental Farm and all their services will be available to visitors and others as in the past.

Farm, where the divisional officers are located, the divisions directly concerned with husbandry being aided and served by the scientific laboratories. The branch farms and stations and the branch laboratories of certain divisions are the main spokes, while carrying the influence still further afield are the sub-stations and 195 illustration stations. The branch farms and other outlying units are in contact with the public continually, co-operate with extension men and serve in many ways. They are close to the farmer and the farmer uses them. Though many agricultural problems are general, most have their local application. Research and experiment dovetail. It is difficult to say where one ends and the other begins.

The Growing Need for Experiment

In olden times when harvests failed famine stalked and people died in droves unless a Joseph were at hand to store against scarcity. Nowadays, alert on its watchtowers, science fends or mitigates many of these disasters, reducing hazards for the producer while assuring more regular and more abundant supplies to the consumer. In both respects national well-being is served.

Growing population brings growing problems. More food must be produced by extended acreage and by intensive production. Less natural conditions for plants and animals are thus created. The denser a population, the more acute the problems of sanitation and hygiene. Species are infected by their own excreta; are beset by the multiplication of their own pests.

When scattered fields of wheat were produced in forest clearings on the North American continent, wheat in the Canadian Northwest was comparatively safe from rust, because the spores did not winter there, at least not to any appreciable extent, and seldom did they invade the region in destructive numbers. When wheat became extensively grown on the plains from Texas to Manitoba, myriads of rust spores were borne by the upper air currents successively north and west, reaching Manitoba and Saskatchewan to blast the crops in certain seasons. The losses became more frequent and more devastating. Cerealists bred rust-resistant wheats, but the plant pathologists discovered that rust spores were sexual and could hybridize, producing new forms capable of attacking other varieties. This complicated the breeding problem, which now seems to be solved at last—though perhaps only for a time.

Complicating Problems

Animals maintained under the artificial conditions conducive to intensive production become prey to more and more ailments, requiring corresponding study and care. Manufacturing processes produce an unending procession of new by-products available for animal feeding, for land fertilization and for other uses. These must be analysed, evaluated, and experimented with to protect the purchasers and to determine their best use.

Commerce and science bring yet other problems. Railroads scatter animal diseases. Plant hunters, scouring the world for beneficial introductions, may unwittingly introduce new fungi, new diseases, even new weeds. The vanguards of science itself must be flanked and rear-guarded by alert scientific watchmen.

Were science to cease her functions, diseases and pests would run rampant, production would fail to keep pace with demand, want and hunger would dog our steps. The doleful predictions of Malthus would all too soon be realized, until Nature again took a hand in her own cruel way, depleting population by starvation and setting races at war, not for riches but for the sheer means of subsistence. Science may not retreat. She must meet new problems, explore new fields, help to create new wealth.

From the day when husbandry was regarded as a job for a strong back and a deft hand, when science was scoffed at as mere theory, the agricultural situ-

ation has completely changed. Science is now recognized as the farmer's indispensable ally. The man on the land, both east and west, looks to experimental farms and other public institutions for guidance in meeting his ever more complex problems. In our public attitude toward science and in our practical utilization of its findings we have during the last 50 years come a long way—how far only the older men realize as they pause in retrospect to glance back along the corridor of time.

A view of the main lawn at Ottawa looking south from the site of the present administration building. This picture was taken in 1903.

New Frontiers

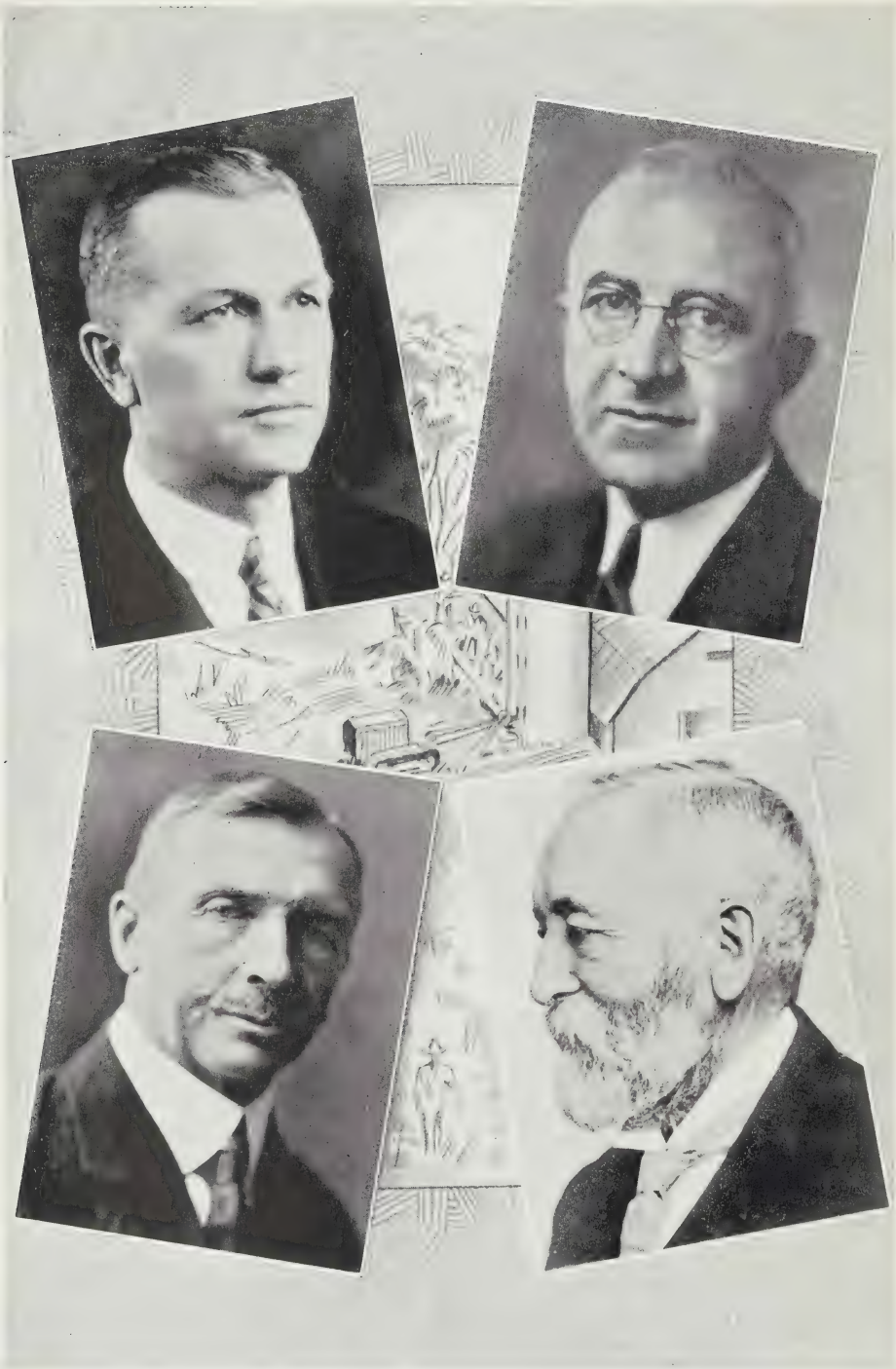
The founders of the Experimental Farm System discerned at the outset that Canada's main opportunity for expansion lay then in the West. The West has been won. Today the problem is to hold our ground there through revised practices while at the same time expanding northward. Still earlier varieties are needed. New conditions confront us in the muskegs and gray wooded soils of the North.

Canada has three fixed boundaries. She has only one direction in which to grow. Europe and Asia are developing to the Arctic Circle and beyond. Canada is unfolding mineral and cropping possibilities in like latitudes, the cropping possibilities especially to the far northwest.

To hold her vacant territory she must occupy and use it. If agriculture be developed in consonance with mining and other occupations the Dominion's population may be largely increased without depressing the prices of her staple exports on world markets. Rather it will strengthen her whole economic structure, helping to solve national problems.

East and west, north and south, the great problem is to promote efficiency, to safeguard production against losses, assuring greater returns per acre and per unit of man power.

We must still press on.



Above—Dr. G. S. H. Barton, Deputy Minister of Agriculture; Dr. E. S. Archibald, Director, Experimental Farms.

Below—Dr. J. H. Grisdale, Director from 1911-1919; Dr. William Saunders, first Director.

Wm. Saunders, C.M.G., LL.D., F.R.S.C., F.L.S., 1836-1914

William Saunders was a prodigy. Born in Devonshire, Eng., June 16, 1836, he came to Canada when but 12 years old, and having received a very limited schooling. He took employment in a pharmacy in London, Ont., at an early age, learned to be a druggist and when 18 years old embarked in business for himself. Shortly afterwards he married Sarah Agnes Robinson, daughter of a Methodist minister. During the next few years he undertook with his wife's assistance a study of the flora of the district, publishing some of his results in 1865.

For his health's sake he bought a 70-acre farm near London, planting it largely to fruit trees. There he undertook to improve varieties of small and bush fruits by selection and cross-breeding. During this period he made a close study of insects injurious to fruits, publishing in 1883 a book recognized for many years as a standard authority on the subject.

Notwithstanding the demands of all his avocations, he advanced rapidly in his chosen profession, founding the Ontario School of Pharmacy and becoming Professor of Materia Medica in the Medical School of the new university at London, Ont. His business also flourished and was continued by two of his sons.

Dr. Saunders founded and became president of the Entomological Society of Ontario, was a president of the Ontario Fruit Growers' Association and a Fellow of the Royal Society of Canada, founded by the Marquis of Lorne. He became its president in 1906. He was also an active member of the American Association for the Advancement of Science, as well as the recipient of many honours and distinctions. He served on investigating commissions for the provincial and Dominion Governments before being appointed to study agricultural experimentation. By self-education he had been well fitted for the task. His immediate successor wrote of him in 1926:

"A man who could, after leaving school at 12 or 13 and going into business for himself at 18, achieve distinction in botany, entomology, horticulture, analytical chemistry, plant breeding, materia medica and manufacturing chemistry by the time he was 40 years old, must surely be considered as a man of most extraordinary ability and marvelous industry. All this, and more besides, was done by Dr. Saunders."

One feels very humble in contemplating what he accomplished with little or no help in the early days of agricultural science. A deliberate manner belied his energy, or perhaps in the long run contributed to his accomplishment.

Upon his appointment as Director he took with him to Ottawa many hundred seedlings of various crosses that he had made at London, and continuing his work with them did much to improve black currants, gooseberries and raspberries.

In tree fruits he made an epochal contribution by inaugurating apple-breeding work using as a hardy parent the Siberian crab, seeds of which were imported in 1887 from the Royal Botanical Gardens at St. Petersburg, Russia. From Russia, too, came the caragana, or Siberian pea tree, the introduction of which into Canada would have won him fame had he done nothing else.

Forage crops did not escape his wide-ranging attention. An outstanding contribution for which prairie agriculture is still indebted to him was awnless brome grass, introduced in 1887 from Russia. Though he may not have been the first to import it to America he was mainly responsible for its general adoption and distribution in the Western World.

And then there is the saga of wheat, a triumph of plant hunting, plant testing and plant breeding, whose greatest fructification was to be realized in other hands. It is fitting that his son, Dr. (afterwards Sir) Chas. E. Saunders, should have been the first to reap where the father had sown.

In most matters he held a tight rein on the public purse—rather too tight at times to suit his employees. But if this were a failing it was one "that leaned to virtue's side".

A dominant characteristic was his love of the beautiful, as the ornamental grounds of the Central Experimental Farm bear witness. To the end of his directorship one of his chief joys was to spend a few spring days planting flowers and shrubs.

In 1886 Queen's University conferred on him the honorary degree Doctor of Laws; Toronto conferred the same degree in 1904. In 1905 he was created a Companion of the Most Distinguished Order of St. Michael and St. George under King Edward VII. He also held the Mantua Gold Medal for scientific distinction.

He died September 13, 1914, in his 79th year, after an illness which lasted nearly two years.

Dedicated to his memory is the new Administration Building erected on the site of his residence at the Central Farm. It is called the "William Saunders Building" and was opened with impressive ceremony on June 6, 1936. Introducing the Prime Minister, the Right Honourable Wm. L. Mackenzie King, who officially opened the building, the Hon. J. G. Gardiner, Minister of Agriculture, observed:

"We are doing honour to a gentleman who established this farm 50 years ago and one who was born 100 years ago. This farm has gone on to do service to agriculture throughout the Dominion."

Dr. Saunders was a man with vision far ahead of his time and builded better than his contemporaries knew. When in 1911 he retired ripe with honours, he had spanned the Dominion with a well-knit system of experimental farms and stations, bequeathing not only great foundations and great accomplishments but a record that inspires, a tradition that continues, a personality that lives.

J. H. Grisdale, B.Agr. D.Sc.

Joseph Hiram Grisdale, the second Director, was a Canadian farm boy, born at Ste-Marthe, Que., in 1870. Graduating from Albert College, Belleville, Ont., he entered the University of Toronto, studying two years with a view to preparation for law. After an interval of school teaching, agriculture claimed his interest and he enrolled in 1896 at the Ontario Agricultural College, where he was an undergraduate student until the next summer. His college studies were completed in 1898 at the Iowa State College, when he graduated as a Bachelor in Agriculture. In 1899 he was called back to his native land and given the important post of Agriculturist at the Central Experimental Farm. Practical knowledge of farming, technical training and a keenly analytical mind qualified him to make a large contribution to Canadian agriculture. As live stock judge and as a Farmers' Institute or convention speaker he was much sought, while his annual evidence before the Parliamentary Committee on Agriculture and Colonization was featured by the press. On the Central Farm he introduced a short crop rotation along with the shallow ploughing advocated by the late Wm. Rennie of the Ontario Agricultural College. The live stock work was built up throughout the system.

He conceived the idea that there was need for local demonstrations of the data available on the experimental farms, and the system of illustration stations was the result.

Becoming Director in 1911 and continuing until 1919, he functioned also as Field Husbandman from 1911 to 1919.

In 1918 Laval University conferred upon him the honorary degree of Doctor of Science.

Forthright in character, he was democratic and sympathetic. A brisk reprimand would be followed by a smile. There was nothing personal and he never held a grudge. He was accordingly liked and respected by his men, especially those who knew him best.

The highest tribute to his worth, however, lies in the fact that when in 1919 the position of Deputy Minister of Agriculture for the Dominion became vacant, he was selected by the Hon. T. A. Crerar, Minister of that Department, to fill the post, being also made Acting Commissioner for Agriculture.

His manifold Departmental activities hardly have a place in this publication, but it may be noted that among many other activities he was advisor to the Canadian Government in the matter of investigations incidental to the lifting of the British Cattle Embargo in 1922.

He is a Fellow of the American Association for the Advancement of Science, a Fellow of the American Genetic Association, and a fellow of the Canadian Society of Technical Agriculturists.

On September 30, 1932, he retired to a farm at Iroquois, Ont., but his services have been since requisitioned in many capacities.

While Deputy Minister, and since then, he continued a staunch champion of the Experimental Farms System that he did so much to build.

E. S. Archibald, B.A., B.S.A., LL.D., D.Sc., F.R.S.

The present Director, Edgar Spinney Archibald was born at Yarmouth, N.S., on May 12, 1885. Passing through primary and high schools he later graduated from Acadia University, Wolfville, N.S., as a Bachelor of Arts. Turning to agriculture he entered the Ontario Agricultural College, graduating in 1908 with the B.S.A. degree.

In 1909 he became Professor of Agriculture in the Nova Scotia Agricultural College, Truro, and in 1912 accepted the position of Dominion Animal Husbandman at the Experimental Farm, Ottawa. In 1919 he succeeded Dr. Grisdale as Director.

Taking charge of the largest system of experimental farms in the world at a particularly difficult time, he tackled the task with the enthusiasm of youth, and with a thorough understanding of the important part played by the Branch in the agricultural development of the country. With the ready co-operation of the Deputy Minister, he launched a policy of further expansion coupled with wider and more systematic investigation, which during his regime he has pursued to the advantage of agriculture and the well-being of the Canadian farmer. By personal visits to branch farms and stations he has kept in touch with all phases of the work throughout the system.

In 1928 he was chairman of a Tobacco Enquiry Commission and also Canadian delegate to the Imperial Research Bureau which met in London, England.

In 1932 he was charged with preparing the technical statement on agriculture for the delegates to the Imperial Economic Conference at Ottawa, heading the technical advisers to the Agricultural Section of the Canadian delegation.

In 1933 he was chairman of the Program Committee of the World's Grain Exhibition and Conference at Regina, being at that time made a Fellow of the C.S.T.A.

In 1935 he was placed in charge of the Prairie Farm Rehabilitation program.

In 1928 the University of Manitoba conferred the honorary degree of LL.D. and in 1930 he received from his Alma Mater, Acadia University the degree of D.Sc.

Besides being a Fellow and past president of the Canadian Society of Technical Agriculturists and a Fellow of the Royal Society of Canada, Dr. Archibald is a member of the American Genetic Association, the American Association for the Advancement of Science, the Canadian Society of Animal Production, the Canadian Geographic Society and the American Geographic Society.

The Old Guard

It is impossible to give credit to all who made contributions important to the up-building of the Experimental Farms System, but a few words about the older members of the staff must not be omitted.

The first two lieutenants were not agricultural college graduates, but being trained in fundamental science, they had the precision, thoroughness and caution that such education develops. Possessing a lively appreciation of the practical bearing of their work, they took care that their recommendations should be applicable. Withal they were gentlemen of fine mind and cultural background, very human in contact with people of all classes.

JAMES FLETCHER, LL.D., F.R.S.C., F.L.S.

Dr. James Fletcher, Entomologist and Botanist, was a prince among men. Born at Ashe, in Kent, England, on March 28, 1852, he was educated at King's School, Rochester, England, and came to Canada in 1874 as a bank clerk, resigning in 1876 to accept a position in the Parliamentary Library at Ottawa, where he had ample facilities for prosecuting his studies in botany and entomology, in both of which sciences he was already well versed. He sought out the few naturalists living in Ottawa, busied himself in collecting specimens, and urged others to do likewise.

Fletcher memorial fountain, erected at the Central Experimental Farm in memory of the late James Fletcher, first biologist of the Experimental Farms.

Appointed in 1884 as Honorary Entomologist to the Department of Agriculture and made Entomolgist and Botanist to the Dominion Experimental Farms, he was also Honorary Entomologist to the Geological Survey of Canada. In biology he found his life work.

Like his chief, he laboured assiduously, collecting, classifying, studying, writing, lecturing, conversing, strewing cheer and kindliness along the pathway of life. He was never too busy to help a seeker after knowledge.

Among many organization activities he took a leading part in founding the Ottawa Field-Naturalists' Club, and was one of the original founders of the American Association of Economic Entomologists, the largest organization of its kind in the world.

Up to the spring of 1895 he had charge of the arboretum and botanic garden at the Central Experimental Farm.

Besides writing much under his own name he prepared the text for that beautifully illustrated book, "Farm Weeds of Canada", and supervised the preparation of the coloured

THE OLD GUARD

1—Sir Charles Saunders. 2—John Fixter. 3—Dr. W. T. Macoun. 4—Dr. F. T. Shutt.
5—Dr. James W. Robertson. 6—Dr. James Fletcher. 7—A. G. Gilbert.

plates, the work of Norman Criddle. The book was published by the Dominion Seed Branch. His annual reports and bulletins contain a vast amount of information about the weeds and insects of Canada and would well repay study by the young people of to-day.

Simple elegance characterized his language, whether in conversation, writing or public address. While seeking to make things plain, he refrained from crudity, for it was not in his nature. The scholar and the man in the street could both enjoy his diction. An effective public speaker, he could quickly bring order out of a contentious discussion.

He was affability itself. A characteristic instruction was, "Just slip it in an envelope and address it to 'the Bug and Weed Man, Ottawa', never mind the stamp." Biologists of to-day might urge more care in forwarding specimens but he wanted to make things as easy as possible for people unfamiliar with science.

Queen's University conferred upon him in 1906 the degree LL.D. For years he was Honorary Secretary of the Royal Society of Canada.

"Why should I take a holiday?" he once replied to a friend's question. "My whole life is a holiday, because I love my work."

But the time came when he had to rest. The busy brain was still, and the biological world mourned one of its noblest savants. He died November 8, 1908, after three years of indifferent health.

A drinking-fountain medallion monument, erected by the Ottawa Field-Naturalists' Club and his many friends, stands on the grounds of the Central Experimental Farm, appropriate memento to a life of service.

FRANK T. SHUTT, M.A., D.Sc., F.R.S.C.

The only one of the Old Guard of technically trained men surviving to help join in the half-century celebration was Dr. Frank T. Shutt, who on September 15, 1933, was superannuated at 74 years of age, relinquishing the dual positions of Dominion Chemist and Assistant Director, which latter he became in 1911.

Son of a civil engineer, Frank T. Shutt was born in 1859 at Stoke-Newington, London, England, coming to Canada with the family in 1870, and living in Toronto, where the young man became private assistant to the Public Analyst of Ontario. In 1885 he graduated from the University of Toronto. As demonstrator in chemistry during the next two years at the University of Toronto he instructed Dr. Saunders' sons.

Appointed Chemist to the Experimental Farms, July 18, 1887, he investigated such practical subjects as the value of clover for the nitrogen enrichment of soil, the economy of applying fresh rather than rotted manure, the causes of soft pork and the factors governing the quality of wheat.

In 1914 he was awarded the honorary degree Doctor of Science by the University of Toronto. In 1929 the American Society of Agronomy awarded him a special prize of $1,250 for his valued contributions to the nitrogen problem of North America. In 1934 he was asked to accept the presidency of the Agricultural Section of the British Association for the Advancement of Science, and the next year was awarded, by the Royal Society of Canada, the Sir Joseph Flavelle Medal. In the same year he was distinguished with the honour, conferred on but few men in Canada, Commander of the British Empire.

Dr. Shutt's work was fundamental and practical. He was very thorough. When a soil sample was taken for analysis, he wanted it so marked and recorded that another sample, if desired, could be obtained in the same spot ten or twenty years in the future. He put the imprimatur of personal attention upon every deliverance leaving his office.

He never jumped to conclusions. When Farmers' Institute speakers from Upper Canada reproached Prince Edward Islanders for spreading on their

fields mussel mud from the beaches, a punster remarking that there was "more muscle than brains in using it", Dr. Shutt reserved judgment until he had examined the red sandstone soil, finding that it required the lime which the mussel mud supplied.

Reluctantly retiring from a work that still claimed his interest after he ceased to draw his salary, he continues, at Rockcliffe Park, Ontario, to keep in touch with scientific research, active for his years, and profoundly respected not only by the farmers of Canada but by scientists throughout the world.

W. W. HILBORN

W. W. Hilborn, the first Horticulturist appointed to assist Dr. Saunders, was born at Sparta, Elgin Co., Ont., in 1849, his early manhood-life being spent at Arkona in the county of Lambton, where he engaged in fruit growing. As a boy his interest was aroused by gathering wild raspberries and noting the difference in the fruit, especially blackcaps. When older, he began testing these blackcaps in the garden, planting wild ones alongside the Mammoth Cluster. The next step was to raise seedling blackcaps. One plant was selected which established the well-known variety Hilborn. Afterwards he turned his attention to the strawberry.

Coming to Ottawa in 1886 to take charge of the horticultural work at the Central Experimental Farm, he was appointed Horticulturist in 1887, and continued in that capacity for two years. Resigning, he purchased a 70-acre fruit farm near Leamington in Essex Co., Ont., which he devoted largely to the peach, cherry, plum, the strawberry and other small fruits.

His experience commended him to the Ontario Minister of Agriculture as a suitable person to conduct in southern Ontario experimental work with fruits. He continued with great success in the fruit industry until his death, December 10, 1921.

JOHN CRAIG

Succeeding Mr. Hilborn as Horticulturist was John Craig, who was born in 1863 at Lakefield, Argenteuil Co., Que. When he was a lad of eight his father moved to Abbotsford, taking charge of the farm of Charles Gibb, eventually acquiring the property.

Charles Gibb had assembled a large quantity of fruit and had accompanied Prof. Budd, of Iowa, to Russia for the purpose of making a collection of Russian varieties of apples. John Craig, therefore, was brought up in an atmosphere of horticultural investigation. He himself had worked with Prof. Budd in Iowa, so that he came to the staff of the Central Experimental Farm in 1890 especially well fitted for his task. He left in 1897 to take over a position as Professor of Horticulture at Cornell University. He died at Ithaca, N.Y., in 1912.

At Ottawa, Craig did a considerable amount of breeding work with apples, attempting a little hybridization but depending mostly upon open-fertilized seedlings of Russian varieties. Three of the varieties which he left and which are still represented are Vesta, Verna and Valois. These proved hardy but not outstanding in quality. None has ever come into commercial use.

W. T. MACOUN, D.Sc.

Modest and ever the gentleman was Dr. W. T. Macoun, who, although not the first Horticulturist of the system, virtually built his division. Son of the famous botanist, Prof. John Macoun, William Terrill was born in Belleville, Ont., in 1869 and, after attending school there removed with the family to Ottawa. Completing a course at the Collegiate Institute he travelled widely with his father on exploration and botanizing trips in Quebec and Western Canada.

Joining the government service in 1888, he assisted the Director in horticultural and cereal work, thus having an important hand in the steps leading to the selection of Marquis wheat, though he never wished his part in this paraded lest it detract from the achievements of another.

In 1898 he was appointed Horticulturist to the Central Experimental Farm and Curator of the arboretum and botanic garden.

His was a particularly well organized division, the achievements of which are reviewed on another page. He wrote much, spoke much, did much. Never dogmatic, he was remarkably accurate and sure. His particular personal attention was given to fruit breeding but his interest encompassed the whole field of his division and extended far beyond. Hobbies were horticulture, good books, poetry and family history.

Sixteen important organizations claimed him for office at one time or another and, during his tenure as chief of the Horticultural Division, ten awards were made to it as well as two medals and two other distinctions given to him personally. Especially prized was the Carter medal, bestowed by the Canadian Horticultural Council for the greatest achievement in horticulture. Of it he was the first recipient. Seven times his division was awarded the Wilder medal of the American Pomological Society for apple-breeding accomplishments and once he received it personally.

Elected a fellow of the C.S.T.A. in 1924, he was its president in 1930. He belonged also to the American Association for the Advancement of Science.

In 1929, Acadia University conferred the honourary degree, Doctor of Science.

A man of active habits, he enjoyed excellent health and during over 45 years of government service had only one day's sick leave up to his final illness. An indisposition early in the summer of 1933 became aggravated while he was attending the World's Grain Show, in Regina, so that he was prevailed upon to curtail his western trip. On August 13, he died.

Dr. Macoun had taken great pride in a perennial border beside his home at the Central Experimental Farm. On the site of his former residence a Macoun Memorial Garden was provided with a sun dial erected with funds contributed by his friends.

The Prime Minister, the Right Hon. W. L. Mackenzie King, in opening the William Saunders Building and the Macoun Memorial Garden on June 6, 1936, paid this dual tribute:

> "It is an honor to do honor to one who has done so much for Canada. It is striking that we should honor Dr. Saunders and Dr. Macoun at the same time. They were very similar in nature and each had a scientifically trained mind. Both were humble-minded and honest, and the qualifications they possessed were extraordinary.
>
> "The real test of greatness is the influence of the life of an individual on the lives of his fellow men and whether his work is carried on by others."

JOHN FIXTER

Faithful co-worker of Dr. Saunders was John Fixter, a practical farmer who, as first foreman, had large responsibilities installing drainage systems, supervising general farm operations, incidentally looking after the bees when they were added, always keeping careful records and earning the high encomiums of his chief.

Born in 1860 at London, Ont., where he was for a time farm foreman for Hon. Mr. Carling, he commenced work in May, 1887, at the Central Experimental Farm, continuing as foreman for 20 years and leaving to become Farm Superintendent at Macdonald College, Ste. Anne de Bellevue, Que. There followed an interval of employment with the Commission of Conservation as a supervisor of field work until in 1915 he returned to the Experimental Farms

Branch to become chief of the new Division of Illustration Stations, filling this position for 12 years with ability and enthusiasm.

He died August 9, 1927, after an illness of a few days following a collapse on a train while returning from an inspection trip to Manitoulin Island.

A. G. GILBERT

Journalist by profession, the first poultryman at the Central Experimental Farm was A. G. Gilbert. Born in British Guiana, he went to Scotland at an early age, and at 17 proceeded to the West Indies, becoming overseer of a sugar plantation; but he was attacked with yellow fever and left for Canada.

After attaining the position of accountant in the Bank of Toronto he took up journalism, serving on the editorial staffs of leading newspapers.

Taking a position in the Department of the Interior in 1882, he studied poultry and became quite successful at raising chickens.

When poultry work was undertaken at the Central Experimental Farm in 1887 Mr. Gilbert was chosen as manager which position he held until 1913, when he was succeeded by Mr. F. C. Elford.

For years the plant at the Central Experimental Farm was the only government fount of information on poultry matters in Canada and as such had a considerable influence. The cotton-front house, built in 1907 by his assistant, Victor Fortier, did much to popularize this type of house in colder climates.

Mr. Gilbert conducted a large correspondence and his bulletins were very useful. He was a genial, kindly man who deserves well of Canadian poultrydom. Shortly after his retirement he passed away on September 24, 1913, at 72 years of age.

JAMES W. ROBERTSON, LL.D., C.M.G.

From 1890 to 1896 that beloved and dynamic Scotsman, James W. Robertson, functioned as Agriculturist at the Central Experimental Farm. His life story lies chiefly outside the sphere of this chronicle but a few notes are pertinent.

Born 1857, he emigrated to Canada at the age of 18 and upon an Ontario farm, with part-time study at a nearby college, laid the foundation for a remarkable career. His first important post was that of Professor of Dairying at the Ontario Agricultural College, and non-resident lecturer in Dairy Husbandry at Cornell University. At 33 he became Dairy Commissioner for Canada, and Agriculturist at the Central Experimental Farm.

Both great men and both self-made, Saunders and Robertson were quite different in temperament. For all his vision there was a certain scientific conservatism about the former. The latter was the great evangelist, passionate with desire to help his fellow men, zealous to proclaim and utilize what was already known. Dr. Robertson appealed more to the workers and to the farming public. Dr. Saunders proved to be the more fundamental scientist. Their paths separated and each won fame in his own way. As the result of an accident Dr. Robertson died March 19, 1930, mourned by his adopted country.

SIR CHARLES E. SAUNDERS, B.A., Ph.D., LL.D., D.Sc.

Third son of the first Director, Charles E. Saunders was born at London, Ont., in the year of Confederation (February 2, 1867), graduated from the University of Toronto in 1888 as a Bachelor of Arts, with honours in science, and subsequently took a post-graduate course in Johns Hopkins University, where in 1891 he received a Fellowship together with his Ph.D. degree.

Devoting himself for some years to the study of music, he came in time to lead an Ottawa choir. About 1895 he became interested in assisting his father in the cross-fertilization of fruits, and later in the cereal investigations.

Appointed Cerealist on January 1, 1903, he began to work over the accumulated material resulting from crosses made by his brother Percy, and from

earlier work done by his father and young Will Macoun. The rest is familiar history.

Ill health compelled his retirement in 1922 from the position of Dominion Cerealist. He received a small pension at first but in response to public opinion was in 1925 granted by Parliament a Life Annuity of $5,000.

Honorary degrees conferred were LL.D. from the University of Western Ontario in 1921, and D.Sc. from the University of Toronto in 1925, In 1921 he was elected a Fellow of the C.S.T.A., and in 1934 was knighted by His Majesty King George V, the only Canadian agricultural scientist to receive such a distinction.

On July 25, 1937, he died at Toronto.

The First Four Superintendents

Among the long list of Old-Countrymen who figured prominently in the early history of the Dominion Experimental Farms System, three of the first four branch-farm superintendents were exceptions. One of them was English, the other three Canadians. They were a sterling quartette of men, fitted for their tasks by nature and experience and inducted into their new responsibilities by a summer at the Central Experimental Farm in association with the Director.

COL. WM. M. BLAIR

Col. William McCurdy Blair was the first Superintendent at Nappan. Born at North River, three miles from Truro, N.S., on May 23, 1836, he was a grandson of Captain William Blair, who served under Col. Winslow in 1758. He was Colonel of the 78th Highlanders from 1880 to 1888, and was twice elected to Parliament. His activities centered around agriculture. He held important local offices and from his farm at North River was the first to supply milk to Halifax by rail from outside points.

In the spring of 1887 he went to Ottawa and had direction of certain development work under Dr. Saunders. The Maritime experimental farm was established the next spring and he moved there as Superintendent in 1888, retiring in 1896. He took an active part in all agricultural development and was the first to introduce a resolution in the local legislature in 1883 on the question of technical education in agriculture. He vigorously urged the establishment of the Nova Scotia Agricultural College.

He died in 1919 at the age of 83, leaving four sons and five daughters. All but one of them still survive. One of the sons has followed directly in his father's footsteps, being at one time horticulturist at Nappan and now Superintendent at Kentville, N.S.

S. A. BEDFORD, LL.D.

Born in 1851 in Sussex, England, the son of a tenant farmer and miller, S. A. Bedford came to Canada with his father's family when he was about 12 years old, the family settling near Goderich, Ont. In 1877 the young man homesteaded near Darlingford, Manitoba. He acted as a guide to new settlers selecting farms and was employed by land companies to examine land. Later, he farmed in the Moose Mountain District, Saskatchewan, becoming a member of the first Legislative Assembly of the Northwest Territories. From 1888 to 1906 he was Superintendent of the Brandon experimental farm, doing good work and establishing himself solidly in the confidence of Manitoba farmers. He had a great love of investigation and always advocated mixed farming and the improvement of home surroundings.

Mr. Bedford resigned to enter business but in 1908 he was appointed Professor of Field Husbandry in the Manitoba Agricultural College, and in 1912 became Deputy Minister of Agriculture for Manitoba. After three years in that position he was appointed Chairman of the Manitoba Weed Commission, in which capacity he acted until he retired from public service in 1923.

First superintendents of the branch farms.

Above—Thomas A. Sharpe, Agassiz, B.C.; Col. William Blair, Nappan, N.S.
Below—Angus Mackay, Indian Head, Sask.; S. A. Bedford, Brandon, Man.

In 1921 the University of Manitoba conferred upon him the honorary degree of Doctor of Laws. A year later the Manitoba Agricultural College conferred its diploma, adding his name and portrait to its Honour Roll.

ANGUS MACKAY, LL.D.

"Grand Old Man of Saskatchewan" was Dr. Angus Mackay, Superintendent at Indian Head for the first quarter century after the establishment of the farm.

Born in 1840 in Pickering Township, Ontario County, Ont., he went West in 1882 with three companions, trekking westward from the end of steel which was then at Oak Lake, Man. Arriving at Indian Head, the four men took up homesteads and operated co-operatively. After employment in 1887 at the Central Farm he was asked the next year to assist in choosing the land for a branch farm and was appointed Superintendent.

Observation led him to stress summer-fallow as a means of farming successfully in the dry years but summer-fallow crop did not always ripen safely so he kept calling urgently on Dr. Saunders for a good early wheat. When Marquis arrived he spotted it as a likely sort.

Diligent worker, he toiled unsparingly, burning midnight oil to help inquirers with letters carefully written in longhand.

Upon his retirement at 73 the Government retained his services in an advisory capacity by making him Inspector of Western Farms, a position he held until the end. Ripe with years and honours, he continued to reside at Indian Head until his death on June 10, 1931, in his 91st year.

He held various responsible positions and in 1922 the University of Saskatchewan conferred upon him the degree of Doctor of Laws. A life-size portrait hangs in the auditorium of the University of Saskatchewan.

THOMAS A. SHARPE

Thomas Alexander Sharpe, the first Superintendent at Agassiz, was born February 7, 1847, at Sharpton, near Kingston, Ont., the eighth child of Thomas and Margaret Sharpe, who had come a few years previously from the north of Ireland.

Educated in local schools, he engaged in various occupations until removing to Manitoba, where he took up unsurveyed land about 15 miles south of where Killarney now is. There he engaged in stock raising, having one of the first herds of registered Shorthorn cattle in the province.

In 1890 he was appointed Superintendent of the newly established branch farm at Agassiz. It was practically in virgin forest, which he cleared, planting extensive orchards and many varieties of ornamental trees and shrubs. Seedlings and cuttings of these were distributed to the general advantage of horticulture throughout the province.

Under his superintendency was carried out some of the cross-fertilization of grains performed by Percy Saunders and it is thought that probably at Agassiz was the cross made which resulted in Marquis wheat.

When in 1911 the Agassiz branch farm was converted largely to dairy and live stock work, Mr. Sharpe moved to Salmon Arm, B.C., where on a substation basis in connection with the Experimental Farms Branch he continued some work with fruit breeding. He died there on October 25, 1929.

A Legacy of Inspiration

One is tempted to tell of others but the tale grows long and a line must be drawn.

The fact that stands out from the biographies already presented is the importance of the personal equation. Neither Saunders nor Robertson had much schooling, Fletcher was largely self-educated in natural science, Macoun had no university training. It is true they lived when agricultural science was largely

in embryo and the field for distinguished attainment much more open than today. It is also true that in perception and methods they led the most highly trained men of their time. All different, all were imbued with the spirit of service; all showed genius.

Genius has been called "an infinite capacity for taking pains". It is more than that. Within great men and women there seems to burn a fire, flaming spasmodically in some, glowing steadily in others, but a fire that will not let them rest without expressing themselves in accomplishment. It is theirs to know the poetry of achievement.

The pioneers of the Experimental Farms System have left a legacy of inspiration to their successors. Well might it be said on their behalf in the words of John McCrae—

"To you from failing hands we throw
The torch; be yours to hold it high."

Although the following pages deal essentially with the respective divisions and other units of Dominion Experimental Farms Service, yet because of limitations of space it has been found impossible to deal adequately with all the many points of contact and co-operative activities with which the various units are associated. The Dominion Experimental Farms Service has always been ready, willing, and anxious to co-operate with farmers' organizations, commercial institutions and other Dominion services, and as time passed and agricultural colleges became established, has also been anxious to co-operate with those institutions.

Clearing land with ox teams and a brush breaker on the site of the Kentville experimental station.

In this publication only very brief reference has been made to co-operative activities, but it may rightly be said that within the past 15 years particularly, Dominion Experimental Farms' co-operation with other institutions in Canada which are conducting agricultural investigational work, has increased continuously until now there is scarcely an experimental or research project conducted on any Dominion or provincial agricultural institution in which Dominion Experimental Farms are not closely associated, either on Committees or in actual co-operation in the work itself.

Reviews of the Various Divisions

ANIMAL HUSBANDRY

EXPERIMENTAL work with live stock has developed since its inception between 1887 and 1890 until it now commands the attention of a large division. In the past the work was largely practical, but it is changing gradually to systematic research, although much of the influence of the Animal Husbandry Division is still manifested by observation and example.

The early tendency was to keep on the Central and Branch Farms a few representatives of a large number of classes and breeds of stock. In time, those which showed no outstanding merits under Canadian conditions were eliminated.

As late as 1925 many of the stations were working with two or three breeds of the one kind of live stock: now only one breed—or, at most, two—of any kind is kept at a branch station. The choice of breed for each station has been based on its determined suitability, on its intended use, and on the majority breed representation in the district.

While these changes were being effected the breeding studies of the breeds maintained became less general and more specific and detailed. In other words, the object has been not so much to create new breeds as to improve existing ones by developing heavy-producing, prepotent strains. One of the main phases of this work is progeny testing and the use of "proven" sires.

Breeding for One Type of Shorthorn

Pure-bred Shorthorns have been maintained on farms in six provinces. The original herds were treated largely as dual-purpose. Later, a certain amount of specialization was practised, some farms concentrating on straight, Scottish beef Shorthorns; others, on English-bred milking Shorthorns. It was found, however, that the two types were drifting too far apart. The straight, beef-type cow, producing a calf as her only revenue, was not sufficiently economical; and the milking type, rapidly losing any semblance of beef form, was developing into a big, plain, rough dairy cow, the bulls from which were a detriment to the beef industry. Recently an attempt was begun in the breeding work on the farms to develop a single type of Shorthorn which would combine good beef qualities with fair to good rather than extremely high milk production, for high milk production had been found to be incompatible with good beef type. In this attempt, good beef-type bulls of Canadian, Scottish and Irish breeding from good-uddered, heavy-milking cows are being used.

Herefords, pre-eminently a range breed, are bred in a co-operative project on the range experiment station at Manyberries, Alberta. Here the relationship of form to function is being closely studied. At Ottawa, a large herd of high-class commercial Shorthorn cows is maintained on a semi-range basis to provide material for cost studies and animals for experimental feeding work. High-class grade Shorthorns and Aberdeen-Angus Shorthorn crosses are being compared.

Dairy-cattle herds—ten Ayrshire, one Canadian, one Guernsey, six Holstein and five Jersey—are maintained on 20 farms and stations across the Dominion. Canadians are kept only in their native province, Quebec, and Guernseys only in Nova Scotia, the stronghold of this breed in Canada; Ayrshires, Holsteins and Jerseys, the leading dairy breeds numerically in Canada, are maintained in seven, six and four, respectively, of the nine provinces.

Raising Dairy Herd Standards with Proven Sires

Ayrshires and Holsteins are the dairy breeds kept at Ottawa; they are used for experimental breeding, feeding and pasture studies. The farm dairy serves

as a means of studying the problems encountered in the handling of milk on the farm, in the farm manufacture of butter and cheese, and in the construction of farm dairies and ice houses.

As already intimated, the breeding work is planned to develop tested strains and proven sires, to build up through them more prepotent races of cattle, and so to reduce the annual wastage from the heavy culling which the use of untried sires makes necessary. A "proven-good" sire is one which has been proved by tests made on a sufficient number of his progeny to be an outstanding, prepotent breeder. Such sires when obtained, are used as fully as possible by exchange between stations: this greatly extends both their period of usefulness and their

Ayrshire cow Relief Lucy (imp)–83933– During her 11 consecutive lactations she produced 134,721 pounds milk and 5,120 pounds fat.

sphere of influence. Breeding work is a long-time process requiring much study, but it may safely be said that much headway has already been made. During this time the farms and stations have fostered and still keep up Record of Performance, Advanced Registry and Selective Registration with pure-bred dairy cattle.

Horses

Draught power on some of the farms and stations was originally supplied by oxen. Horses gradually displaced the oxen, only, in their turn, to be extensively replaced later by tractors—particularly in the western provinces, during the boom period just prior to 1930. But horses were never entirely replaced, and in the difficult times from 1930 to 1935 they were again in considerable demand.

The breeding of heavy draught horses has received particular attention. Clydesdales, early commanding attention, were maintained on a number of the stations, particularly in the West, during the period from 1914 to 1920. Shires were introduced in 1923 but did not withstand the conditions nor meet with the complete approval of Canadian horsemen.

Interest in horse breeding lapsed for a period around 1930, but has distinctly revived since then. During the last few years, with the assistance of the Live

Stock Branch of the Department of Agriculture, the division has placed on experimental farms and stations across Canada eight Clydesdale, five Percheron and one Belgian stallions. They stand under a Premium-Mare policy by which special consideration is given to outstanding pure-bred mares with the object of breeding as many of these as possible in order to reduce the present distinct shortage of good Canadian-bred draught stallions.

Mention must also be made of the rehabilitation work with Canadian horses in the province of Quebec. This work originated at Cap Rouge and was later transferred to the St. Joachim Horse-Breeding Station under an agreement between the Canadian Horse Breeders' Association, the Quebec Department of Agriculture, and the Dominion Department of Agriculture. Foundation mares were purchased and careful breeding and selection were practised, with the result that large numbers of superior stallions and mares have been made available to breeders. In recent years, the breeders have been organized into clubs in certain well-defined areas, and surplus stock has been sold only into these club areas. By this establishment of breeding centres, the breeders should be in a position to carry on without further assistance when the agreement expires in 1940.

Breeding Sheep for Specific Purposes

Sheep breeding is a minor yet important phase of animal husbandry work. Here again there has been a process of evolution from the early keeping of representative flocks of many breeds to the present day specialization. In the

Market lambs on alfalfa pasture at the Experimental Farm, Ottawa.

Maritime Provinces, and in most of Quebec and in Ontario, sheep of the Down breeds, particularly Shropshires, are being bred in flocks of demonstration size; and in those parts of Quebec where the home spinning of wool not only is still practised but is increasing, flocks of long-wooled sheep of the Leicester breed are maintained. In Western Canada, farm flocks of Hampshires and Shropshires are kept, and in British Columbia the production of hot-house lambs with Dorset Horns is being studied.

Range production is a most important phase of the Canadian sheep industry. At Lethbridge the Corriedale breed is being studied in an endeavour to develop a range sheep combining good meat and wool qualities with ranging ability. At Manyberries, Romneys are being used in a similar experiment. In each of these studies the Rambouillet is employed as one of the parents because of its wool quality, hardiness and herding instinct. The other breeds provide the fleshing qualities. This is a long-time project.

Concentrating Upon One Breed of Swine

Representatives of almost all the known breeds were originally maintained on one or another of the farms and stations. Demands of the export bacon trade gradually reduced the representation in Eastern Canada to Yorkshires, Berkshires and Tamworths. In Western Canada, the heavier breeds, Duroc-Jersey and Poland China, after an early popularity are finally giving way to the bacon breeds. With the increasingly exacting demands of the bacon trade, virtually all but the Yorkshires were finally eliminated, this breed having proved to be the most suitable for the production of export bacon. In 1934 an importation of Swedish Landrace hogs was made for experimental purposes. This breed, recognized as one of the greatest rivals of the Yorkshire for bacon production, is being evaluated under Canadian conditions.

Breeding Methods and Projects

The breeding methods followed are *pure-breeding*—including line-breeding and in-breeding, *grading-up*, *cross-breeding*, and *hybridization*. By far the greatest emphasis is placed on the breeding of strains that are pure for the characters desired. Progeny testing is one of the outstanding developments in pure breeding; it is possibly best exemplified by the pig-testing-station project of the Dominion Department of Agriculture.

Only two attempts to develop new breeds are being made. Rambouillet ewes are being crossed with Corriedale and Romney rams as the initial step in an endeavour to develop a type or breed more suitable to western range conditions. This work has given some very promising results. Reciprocal crosses between domestic cattle and buffalo are being made in the hope of developing an animal, tentatively named the cattalo, embodying the hardiness of the buffalo and the beef qualities of the domestic animal. Such an animal would be useful on the northern plains area. The difficulty is lack of fertility in the hybrid males. Individuals carrying as low as one-fourth and one-eighth buffalo blood have been tried without success, but great faith is placed in one now on hand carrying one-sixteenth buffalo blood. This project is being conducted at the cattalo enclosure, Buffalo Park, Wainwright, Alberta, in co-operation with the Lands, Parks and Forests Branch of the Dominion Department of Mines and Resources.

Genetics.—In breeding, the principles of animal genetics are closely followed. The services of the divisional geneticist are available to the officer in charge of each class of stock. Each breeding program is thoroughly reviewed in advance from the genetical standpoint, and is followed through on the same basis.

Artificial Insemination.—The old idea of artificial insemination is now receiving renewed attention in many countries. Preliminary work in developing the proper technique and transportation methods is being carried on at the Central Farm, particularly with horses and cattle. Coupled with the development of proven sires it offers an almost unlimited opportunity for the rapid improvement of certain classes of live stock.

Feeds and Feeding

During the past 50 years great changes have taken place in feeds and feeding. First ensilage crops of various kinds were developed, and corn emerged as the

greatest of all silage crops under suitable climatic conditions. Later, peas-and-oats, legume and sunflower silages were tested for those areas where corn would not grow to advantage. Then came the recognition of alfalfa as the legume hay *par excellence* for virtually all classes of stock. Coarse farm grains and mill and factory by-products received recognition and evaluation. Particular attention has been paid to sources and quality of protein in swine feeding. Latterly, the importance of minerals and vitamins commanded consideration. Research facilities have been recently provided and co-efficients of digestibility are being obtained for Canadian feeds where heretofore it has been necessary to rely on data from outside Canada. A feature of the work in recent years has been pasture improvement, in which sheep, beef cattle and dairy cows have been used to measure the quantity and quality of pasture herbage under varying fertilization treatments. As a result, there is a renewed interest in the value, care and management of pastures for live stock.

Housing

Many types of buildings, equipment and accessories have been tested. The more permanent buildings, as those for cattle and horses, have been gradually improved, the important factors of economy, practicability and sanitation being always kept in mind. The important problem of ventilation, with its co-problems of insulation and condensation, has been studied, and plans showing the essentials of construction of buildings for housing the various classes of stock are now available. Assistance is given in planning the renovation of old buildings and in the laying out of new ones. With certain kinds of stock, notably beef cattle, sheep and some classes of swine, it has been found that cheap, open-front shed shelters, with corrals, give excellent results at comparatively little cost, so that in later years this type of construction has been featured wherever possible. Equipment and accessories, such as stable fittings, identification devices and utensils, both home-made and commercial, have been carefully tested, direct statements and comparisons being made possible.

Health and Hygiene of Farm Animals

In co-operation with the Health of Animals Branch, a high standard of health in the live stock has been maintained. Two diseases, tuberculosis and contagious abortion, which were the dread of the cattle breeder, and which, in their day, took heavy toll in the experimental farm herds, have now been virtually eliminated by the tuberculin and blood tests. At present another problem of major importance to dairymen, the high incidence of chronic mastitis in dairy cows, is receiving consideration from the diagnostic and prophylactic points of view. Deficiency diseases evidenced by bone-chewing in cows, goitre in new-born calves, absence of wool and hair in new-born lambs and pigs, and joint-ill in foals, have been shown to be preventable by the simple procedure of feeding the proper mineral supplements, principally calcium, phosphorus, iodine and iron, at the proper time. Practical methods of eradicating external and internal parasites in the various classes of stock have been demonstrated. While the study of animal disease is not a part of the work of this division much has been and is being done, particularly in a preventive way.

Records and Data

Routine-like as record-keeping may seem, the value of data collected from day to day and year to year becomes increasingly evident. Rearing costs, production costs, gain-per-pound-of-feed ratios, and other data are being called for at all times, and their collection alone would justify the maintenance of many of the herds, flocks and studs.

BACTERIOLOGY

The youngest division of the Experimental Farms Branch was created in 1923. On every hand farm problems arise which are directly related to the activities of micro-organisms. The work in bacteriology has developed in two directions: (1) research and experiment, and (2) direct service to farmers.

Clean Milk Production Involves Control of Bacteria

Not only is pure, clean milk essential for the fluid milk trade, but the welfare of the whole dairying industry is related to the quality of the raw supply. Hence the study of sanitary milk production under average farm conditions has received much attention. Investigations showed that the chief contributors to contamination were the animals and the utensils. High sanitary quality was found to depend not upon elaborate, expensive equipment but rather upon care taken by the producer himself to guard against the main sources of infection.

Keeping quality depends upon the final factor in milk sanitation—cooling. Experiments have indicated the great importance of prompt cooling in helping to preserve the effect of the lactenin, the substance in freshly drawn milk which is capable of restraining bacterial growth, but which soon loses its effect if milk is not promptly cooled. A clean cow, a clean pail and prompt cooling are the main factors in clean-milk production.

Sterilization with Chlorine Disinfectants

The importance of the utensils in milk sanitation led to a detailed study of sterilization methods applicable to the average Canadian dairy farm, where cost and time must be considered. Germ infection from utensils may be controlled by steam or abundant hot water, but few farmers are equipped to use these agents effectively. The need for a practical alternative led to a study of the use of chemicals.

It was found that chlorine disinfectants controlled contamination from utensils simply and efficiently. A study of their action showed that the less alkaline disinfectants were the more effective but that, on the other hand, such quick-acting products were more corrosive than the more alkaline ones. However, in actual practice, when utensils are treated just before use, the contact period is so brief that corrosion is insignificant.

Practical tests on 39 farms have shown that rinsing utensils with a quick-acting hypochlorite solution (100 parts chlorine per million) resulted in a distinct improvement in the bacteriological quality of the milk.

Simplest Method of Cleansing Milking Machines

Serious contamination of milk may occur in milk drawn by machine if the apparatus is not properly sterilized. Many of the methods of treating the tube system were too cumbersome and time-consuming. The quest for a simple yet effective procedure resulted in the development of the simplest method yet devised for cleansing milking machines: Cold water is drawn through the tube system, after which it is kept filled until required, with weak lye solution (0·3 to 0·5 per cent). Five years' experience indicates that contamination from machines may be kept at a minimum by use of this simple and cheap method. For the maintenance of cream separators in sanitary condition similarly effective measures have been devised.

Methods in Milk Analysis

It is important to be able to recognize good milk as well as to produce it. The methylene-blue test has been of much value in detecting milk of poor keeping quality. With the higher grades of milk, however, it is not sufficiently

delicate, and the plate-count method is too expensive for the ordinary routine control of raw-milk supplies.

The division has developed a modified methylene-blue test which is more convenient and which shows better agreement with actual keeping quality. In addition, it shows greater accuracy with the better grades of milk.

For the highest grades of raw milk and for pasteurized milk the standard-plate-count method is used for official control work. Studies in procedure have indicated improvements of technique which not only increase the accuracy but detect types of germs not brought out by the standard method.

Studying milking machine sanitation with an "artificial udder" from which sterile water is "milked" to determine bacterial contamination from the machine.

Inoculation of Legume Seed Pays

The importance of soil microbiology is becoming better realized with the growing knowledge of the part played by microbes in the production of plant food and in the maintenance of soil fertility. The treatment of legume seed with cultures of bacteria is an important practical application of soil microbiology. As the bacteria in the root nodules of a legume crop may assimilate from the air each season 40 to 100 pounds or more of nitrogen per acre which would otherwise have to come from the soil, the importance of establishing the proper bacteria in the soil may be understood.

Experiments at Beaverlodge, Alta., have shown the importance of seed inoculation in the establishment of successful stands in areas where legumes are being introduced. It was also demonstrated that inoculated seed held for several days may give as high yields as that sown immediately after treatment, a matter of practical importance when treated seed for some reason must be held before sowing. Field and laboratory work have also demonstrated variations in effectiveness between different strains of the legume bacteria and have shown the importance of using an efficient strain for inoculation.

Information on what success is obtained by the man on the land with seed inoculation has been accumulated through reports on co-operative tests with farmers supplied with nitrocultures. Approximately 2,500 reports by farmers indicate a benefit due to inoculation in 78 per cent of cases. Treatment has proved successful not only with alfalfa, sweet clover, and soybeans, but often red clover, peas, vetches, lupines, etc., have been helped. The reports confirm the belief that reinoculation may be of value by thus introducing a good strain of bacteria better suited to the soil than those which may be already present.

From time to time the division has investigated cultures stated to be suitable for all crops. None of the preparations has been found of practical worth. Inoculation is recommended only for legumes.

Soil Bacteria Live Through Winter Cold

Studies on the effect of the winter season, when the soil in a large part of Canada is frozen, indicated that bacteria survive in undiminished numbers when growth is suspended. Though decomposition of plant residues is halted the loss of plant food by leaching of nitrates is likewise prevented, and the dormant life springs into activity as soon as the frost leaves the ground. The ability of nitrogen-fixing bacteria to survive freezing is believed to be an important factor in successful legume cultivation in regions with severe winters.

Studies directed towards the kinds as well as the numbers of bacteria in soil have shown relationships between crop yield and certain types of soil bacteria not brought out by simply counting germs, and suggest applications of microbiological methods for estimating the fertilizer requirements of soils.

Bacteriology Helps the Beekeeper

Certain micro-organisms cause disease among bees; others spoil honey. The larval disease known as American foulbrood is the most serious scourge of Canadian apiaries, and to cope with it prompt recognition is essential. The causal germ is not recognized by ordinary methods, but an improved medium for its cultivation and a biochemical test for the organism in cultures have been developed. The cause of European foulbrood is still a matter of doubt. Studies have led to a revision of the present theory as to the organism responsible, though the question is by no means settled.

Spoilage of honey by fermentation may cause much loss to beekeepers and others. The agents responsible were found to be a special group of yeasts capable of thriving in high percentages of sugar which suppress most germs. The yeasts may be carried with the nectar by the bees, and apiary soil may in time become heavily infested. All honeys were found to contain these yeasts to some extent, the tendency to spoil depending on the numbers of yeasts and the moisture content of the honey. A method of analysis was devised which would indicate whether a given sample could be expected to keep for at least a year.

Studies on spoilage prevention showed the importance of sanitation at the time of extraction. It was also possible to prevent fermentation by pasteurization, cold storage or the addition of small quantities of preservatives.

Freezing Foods Does Not Sterilize Them

Although freezing maintains vegetables and fruits in excellent condition, the process is by no means one of sterilization. Products frozen at 0°F. may contain sufficient living organisms to develop after defrosting and cause spoilage unless the products are consumed promptly. When care is exercised in preparation, when products are handled to ensure prompt and uninterrupted freezing, and when consumption is not delayed after defrosting, frozen fruits and vegetables may be regarded as hygienically good products.

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Attention has recently been given to canned goods, particularly tomato products, in a co-operative effort with the Fruit Branch of the Department of Agriculture towards the improvement and maintenance of hygienic quality. This has led to the adoption of a standard based on the microscopical examination of the products which has resulted in a substantial improvement in the output of Canadian canneries.

Meat Packing and Storage Problems

Research on the preservation of chilled dressed poultry showed that with birds stored at 30°-32°F. the deterioration to the point where they acquire a noticeable odour is essentially a surface spoilage, without any significant bacterial action on the muscular tissue. At the lower temperature storage life was found to be one week longer than at 32°F.

Meat packing problems are also concerned with bacteria, some of which may cause loss by causing sliminess and taints while others are desirable types which participate in the curing process in the preparation of bacon, hams, etc. The work so far has been directed towards a study of curing and has resulted in an improved understanding of the action of micro-organisms in the process.

A related study, in co-operation with the National Research Council, was made of the cause of the red discoloration of salted hides, which occasions loss in the leather industry through spotting and weakening of the fibre. Two organisms were found to be responsible, one of which was similar to that causing a similar discoloration of salted cod fish in Eastern Canada.

Direct Service to Farmers

More and more samples of farm well water have been submitted for analysis each year. Some require only routine testing; others demand extended investigation. Of more than 1,600 samples of well water analysed, 35 per cent were satisfactory, 32 per cent were polluted and 33 per cent were of doubtful quality. These percentages indicate that on many farms location and construction of the well leave much to be desired and stress the need for avoidance of surface contamination.

During 12 years the division has prepared and distributed to Canadian farmers 49,000 cultures for legume inoculation. This has been of great assistance in helping to extend successful legume cultivation in many parts of the country. With this service special aid has been given to farmers in drought areas in Western Canada in their efforts towards rehabilitation.

BEES

The first apiary of the Experimental Farms Branch was established at Brandon, Manitoba, in 1889, but apiaries of different sizes have since been started at one or more of the branch farms in all provinces. At present there are 17 such apiaries varying in size from 12 to 127 colonies, and totalling approximately 770, for experiment and demonstration.

Prior to 1915 the work was under the supervision of the Entomological Division, but when the entomological work was separated from the Experimental Farms Branch, the bees were committed to a newly formed Apiary Division. A few of the many projects undertaken since that time are briefly reviewed.

One of the first experimental projects undertaken by the new division, co-operating with the Chemistry Division, was to test for strength and economy the various brands of foundation then available for the use of beekeepers. The results of a three-year test indicated that a foundation measuring 7·5 to 8 feet per pound was the most satisfactory, figures which were verified by further tests conducted during 1923 and 1924. The foundation now in general use is one running seven to eight sheets, or approximately 7·5 feet, per pound.

Bees do not Puncture Fruit

During those early years many fruit growers complained that honey bees were doing considerable damage to ripe fruit by puncturing the skin and extracting the juices. During the autumn of 1901 and again in 1902, when the flowers had ceased secreting nectar, four strong colonies of bees were selected, all food was removed from them, and in each colony six varieties of ripe, thin-skinned fruits were suspended. Some were untreated, some were dipped in honey and the skins of some were purposely punctured. The fruit was left in the hive for one week and then was replaced by fresh fruit. At the end of the third week the bees began to die of starvation, notwithstanding the fact that only the thin skins of the fruit stood between them and food. Not once was the skin of sound fruit broken, but that which had been purposely punctured was sucked dry, proving that honey-bees are not responsible for original injury, but that they work only on fruit that had been previously damaged.

The main apiary at Ottawa just before the removal of the season's crop of honey.

Swarm Control Investigation

One of the major problems of beekeeping is that of swarm control, for swarming entails loss not only of the honey crop, but of the bees as well. The instinct to swarm can be largely subordinated by allowing sufficient room for brood rearing and for the storage of surplus nectar at all times and by providing comfortable working conditions within the hive. In spite of these precautions, however, there will always be some colonies that are determined to satisfy the instinct for natural increase. Several methods of treatment have been evolved whereby natural swarming may be prevented and colony increase controlled. The most effective and lasting treatment is to remove the old queen from the colony as soon as queen cells containing eggs or larvae are discovered and at the same time to destroy these cells. The colony is left queenless for ten days. On the tenth day the queen cells are again destroyed and a young laying queen is introduced. If increase of colonies is desired, one or two combs of emerging brood with

adhering bees may be taken from the colony at the time the old queen is removed and placed with this queen in a new hive, the hive being filled up with drawn comb or foundation. The nucleus thus formed will build up into a strong colony by autumn, if it is not made later than the middle of July. Two such nuclei may be established in one hive by dividing the latter into two compartments with a solid division board, and thus a surplus of queens may be carried through the winter for early spring replacements.

The experimental apiary at Ottawa during the winter.

Package Bees from the South

Experiments have been conducted to test the value of package bees to the honey producers of Canada, the time they should be imported and the most economical size of package for all purposes. Losses from poor wintering and disease are often heavy and it is virtually impossible to make replacements unless new bees can be imported from the southern United States. Experiments have shown that package bees are a cheap and easy means of replacing losses or of establishing new colonies in any part of Canada. The two-pound package with queen appears to be the most economical for the honey producer, and should arrive not later than the second week in May, preferably during the last week of April. Package bees are more profitable in the Prairie Provinces or in regions where the main honey flow comes towards the latter part of the summer and extends until frosts, than in districts where the flow comes early.

For the fruit grower who needs bees for pollination purposes and cannot obtain good, over-wintered colonies, the five-pound package is the best because the stronger the package the larger the force of field bees sent out to work the blossoms.

Races of Bees

The Italian race of bees is the most common in Canada, but many consider the Carniolan and Caucasian bees to be superior to the Italian. In a comparative test of the three races made at Ottawa during the past 11 years, the Italian bees always led in the amount of honey produced. These results have been verified by test at other experimental farm apiaries.

Honey Storage

In 1929 some 200 samples of honey were secured in duplicate from the different producing areas of Canada. In co-operation with the Divisions of Chemistry and Bacteriology a chemical and microbiological analysis was made of one set of these samples. The other set was graded according to colour and quality and was placed in general storage, observations being made of any physical changes that might take place. Samples secured from the crops of 1931, 1935 and 1936 were also submitted to the same tests. These tests are used as a basis for the inspection and grading of honey for export and interprovincial trade.

Honey Cookery

Because of numerous demands for information on the use of honey in cooking, canning and preserving, experimental work in these processes was begun during the winter of 1933-34 and continued for three years. Numerous receipes have been developed in which honey may be used to replace sugar in part or in whole. These recipes have been published in bulletin form and in various bee journals.

BOTANY

As a separate unit with a very small staff the Division of Botany began its activities at the Central Experimental Farm in 1909. It was faced, however, with so many problems of economic importance and the demands for its services were so insistent that its development was rapid. Within 20 years the division was operating from the central laboratory at Ottawa, ten branch laboratories distributed from coast to coast.

The demands made upon the division were mainly for advice and help in the fight against the destructive diseases attacking crops of all kinds; and one of the first tasks was to organize as efficient a plant-disease service as the available funds and staff would permit.

The fight against plant diseases can be waged by preventing their introduction into the country, by growing resistant varieties, by seed selection, by seed treatment, by protecting growing plants from disease, by pruning, and by cultural methods, crop rotations and soil dressings. All these methods have been adopted by the division, another being tried when one failed.

Preventing the Introduction of Disease

In 1909 the occurrence of wart disease of potatoes was reported from Newfoundland. If this disease had spread to the Dominion, Canada's valuable seed-potato export trade would have been lost, for the importing countries would have placed a rigid embargo against Canadian potatoes. Drastic and effective measures were immediately taken, however, and the Dominion is still free from one of the most destructive of all potato diseases. This incident led to the passing of the Destructive Insect and Pest Act, which enables Canada to close her doors against the importation of any plants and plant products that might introduce dangerous diseases. But for the passing of the Act the number of destructive plant diseases of the Dominion might well have been increased by now.

Resistant Varieties—Battling Against Wheat Rust

Resistant varieties are undoubtedly man's best weapon against plant diseases; but as there were virtually no varieties of commercial value that were resistant to the diseases so costly to Canadian farmers, the Experimental Farms Branch turned its attention to the breeding of resistant varieties, and the Division of Botany took an active part in this work. The first and major endeavour was to produce commercial varieties of wheat that would resist the attacks of stem rust.

It has been known for many years that the barberry is a necessary factor in the life cycle of the organism causing the stem rust of wheat; and the first step in the campaign against the disease was to eradicate this shrub from the Prairie Provinces. This was begun in 1916 and was completed by 1925; but the results were disappointing, and it was concluded that the small number of barberry bushes present had never played an important part in the outbreaks of rust in Canada. Later investigations proved that the disease was introduced each year into Canada by spores that were carried by the wind.

The losses caused by rust were so severe that they became a matter of national concern and in 1924 the Dominion Botanist addressed the Select Standing Committee on Agriculture and Colonization of the House of Commons on this serious problem. A special appropriation of $50,000 was voted to establish a Rust Research Laboratory at Winnipeg, Man., and this was opened in 1925. Its main purpose was to take a guiding part in the breeding of rust-resistant varieties of cereals. The task proved difficult and complicated.

The botany building which houses the laboratories and offices of the division. The greenhouses are seen in the rear.

Many Forms of Rust Occur

The organisms that cause the different cereal rusts are not simple entities, but each consists of a number of different strains, called physiologic forms. A cereal variety may be highly resistant to certain forms, moderately resistant to some others, and quite susceptible to still others. In stem rust of wheat about 50 different forms have been found in collections of this rust made in Canada In Western Canada a number of different forms are present each year, but usually only two or three predominate. Forms that have been most prevalent for several years disappear or become of minor importance, and are superseded by a few others which assume the dominant role. The latter, in turn, give place

to yet others. Why these changes take place is not understood, but the fact that they do occur serves to explain in some measure why a variety of wheat may be resistant in some years but not in others. It also emphasizes the necessity of breeding and growing wheat varieties that are resistant to all forms of stem rust.

With the object of discovering resistant varieties of value to the plant breeder in his efforts to produce rust-resistant varieties of satisfactory commercial quality, a great many varieties of cereals are tested to determine their reactions to the rusts that attack them. Having this information available, the plant breeders are enabled to select for their crossing material those varieties or strains that give most promise of producing progeny of the type desired. Similar tests are carried out on the many new strains produced by the plant breeders in order to eliminate any of these which do not show sufficiently high resistance.

Crop Protection by Chemical Treatments

Owing to the complex nature of the different rusts and to difficulties inherent in the plant-breeding work, it was thought advisable to investigate the possibility of preventing rust infection by applying different fungicidal dusts to the growing crops. Of the dusts tried, sulphur proved to be the best. The most effective and economical rates and frequencies of application were determined. Although sulphur dust will prevent infection of all cereal rusts, the market price of the cereals has been too low during the last few years to make this method a profitable general farm practice.

It will be seen that many years of patient work were required to produce resistant varieties. A new variety, Renown, was eventually developed at the Winnipeg laboratory, and was offered for sale for the 1937 seeding. Other types that promise to excel Renown in certain respects are in process of development.

The ultimate aim of plant breeding at Winnipeg is to produce varieties resistant to all the important cereal diseases. Investigations have been conducted, therefore, dealing with the identification of different strains of cereal smuts; and tests have been made to determine the resistance of rust-resistant wheat varieties to common root-rot.

Breeding Disease-Resistant Potatoes—Potato Inspection

Potato breeding conducted in co-operation with the Fredericton experimental station is yielding some promising results in the development of disease-resistant potatoes. More than 30,000 new productions have been examined.

Good seed has been regarded as a fundamental to good farming since the earliest days; but the quality of seed cannot always be judged by its appearance. This is particularly true of seed infected with virus diseases, for these can be detected only in growing plants. Seed that appears to be quite sound and healthy may be badly infected and give poor, unprofitable crops.

A survey of potato fields in 1914 showed that almost all the fields visited were badly affected with the virus diseases, leafroll, and mosaic, which meant that the crops were useless for seed purposes. This led to the organization of the seed-potato certification service, to aid in the production of sound and vigorous seed as disease-free as practically possible. Foundation stock was taken from the best fields in the Maritime Provinces, and crops from this stock were inspected during the growing season so that the amount of virus and other diseases could be ascertained. A standard, necessarily low at first, was set for the percentage of diseased plants and foreign varieties permitted; and crops from the fields coming within this standard were eligible for official certification tags. At the start 12 per cent combined diseases and 5 per cent foreign varieties (mixture) was the tolerance allowed. After seven years field inspection work the average total of the three principal diseases (leafroll, mosaic and blackleg)

found in all fields inspected had been reduced to about 6 per cent. In 1935 the averages of disease in the fields passed for seed certification were: leafroll, 0·05 per cent; mosaic, 0·14 per cent.

The success of this type of service indicates its practicability and shows that virus diseases can be kept within reasonable bounds. Many fields have been maintained virtually free of disease for some years. The seed-certification service now enjoys a world-wide reputation and has secured lucrative export markets. During the past ten years an average of more than 20,000 acres of potatoes have been inspected annually, resulting in an average annual production of 4,000,000 bushels of certified seed and an average shipment of more than 1,250,000 bushels a year.

Seed Treatments for Smuts and Root-Rots

Much work has been done on seed treatment for disease control, and a large number of destructive diseases are held in check by this means. Recent experiments have shown that even Elite seed is not always free from disease organisms, and proper seed disinfection not only destroys fungi that may be on the seed itself but also affords the seedlings, during early growth, protection from the parasitic fungi in the soil.

Seed treatment has proved an adequate control measure against the destructive smuts and has given beneficial results against the ever-present root-rots.

Protecting Growing Plants

Sprays and dusts have proved efficacious in protecting growing vegetation from blights, mildews, and other ills. A great many fungicides in both spray and dust form have been tested from year to year, and full information on the results and recommendations have been made available for distribution. Apple scab can now be effectively controlled. Thorough spraying has proved a satisfactory means of checking late blight, so destructive in some years to potatoes in Eastern Canada.

Pruning is the basis of measures recommended for the control of certain diseases of fruit trees, such as peach canker, fire blight, black knot and brown rot. Crop rotations have been studied in connection with soil-borne diseases, such as root-rots and potato scab, and definite recommendations have been made.

Physiological Disorders of Plants

In addition to its activities against plant diseases, the division has conducted successful investigations on certain physiological disorders. Three of these, drought spot, corky core, and die-back of apple, arise from a complex of similar unfavourable environmental conditions and are believed to be closely allied. Together they are responsible for very severe losses. They occur usually on trees growing in shallow, open soils where adequate soil moisture has not been maintained, or on deep, heavy soils where drainage is poor and where excess moisture collects during the growing season. A correction of the soil moisture conditions has sometimes, although not always, remedied the trouble. Nitrogenous fertilizers have increased the amount of disease on susceptible trees, and heavy applications of potash fertilizers have decreased it. In recent experiments the application of boric acid as a spray or a soil top dressing entirely eliminated drought spot and corky core from the following year's crop.

During the past four years considerable attention has been focussed upon a study of the nature, cause, and prevention of turnip brown-heart. It has been learned that brown-heart is due to a lack of boron in the soil and that its control is effected by the use of borax applied at the rate of ten to fifteen pounds per acre. These findings now make it possible to produce turnips entirely free from this destructive disease. It has been established, further, that the liberal use of

barnyard manure evidently increasing the amount of boron in the soil, helps to control brown-heart, while its development is promoted by the use of lime, either as ground limestone or in hydrated form.

On the Trail of Plant Diseases

A plant-disease survey of the Dominion was begun in 1920 and mimeographed reports have been published almost every year since then. These are compiled from information gathered by plant pathologists and other trained men through personal observation or from enquiries of correspondents. In them is recorded the distribution and prevalence of plant diseases, the appearance of new diseases, the influence of the weather on the development of plant diseases, and observations on susceptibility or resistance shown by different varieties to some of the more prevalent diseases.

Besides being the best sources for information on the occurrence or prevalence of any disease, these reports serve two very important purposes. Importing countries, knowing the danger of introducing diseases with vegetation, are becoming watchful of their plant importations and of the countries of origin. The maintenance of an efficient plant-disease survey establishes confidence and thereby promotes international trade. Possibility of the introduction of new diseases into the country still exists in spite of the regulations governing plant importations. The plant-disease survey does much to assure the prompt notification of such introductions. Immediate and adequate steps can then be taken to deal with them, reducing to a minimum the chances of their spreading and becoming permanent dangers.

The development of a plant-disease service in any way adequate to deal with the urgent demands made upon it, used up a very large part of the funds made available to the division and resulted in the comparative neglect of economic and agricultural botany, which are also of primary importance.

Surveys Aid in Control of Farm Weeds

The ruinous toll levied by weeds in Canadian agriculture demands not only direct experiment with methods of control but the study of the weeds themselves and of their relation to the farming environment. A knowledge of the occurrence, range and spread of each imported or native weed is necessary, and records are now on file for more than a thousand species. Charts are being made to show frontiers and plague centres of those that are spreading. Local and regional lists of weeds and known distributions of particular weeds are prepared as required.

Studying Pasture Vegetation

For nearly ten years, experimental pastures and plots throughout the eastern provinces have been studied to determine how vegetation changes under various soil treatments and pasture management. Percentages of such species as Kentucky blue grass, timothy, brown top, white clover and mosses have altered remarkably in certain of the trials, affecting yields and quality of herbage. Some weeds have been readily suppressed, but others have maintained themselves in competition with improved herbage. Grasses generally have responded to fertilizers, particularly to nitrogen, more than legumes and weeds. The clovers have been helped by superphosphate and thrive best in the absence of shading and too dense sward.

Poison Ivy; Hay Fever

Poison-ivy habits and eradication have also received special attention. Its prevailing occurrence on shallow rocky soil almost demands a chemical warfare, and at present sodium chlorate as such or in trade preparations best meets the requirements. On arable land cultivation has been found sufficient.

The growing interest in zones free from hay fever has necessitated careful attention to ranges of ragweed and other offending species, and classification of them as wind- or insect-pollinated plants.

Reference Collections of Botanical Specimens

The botanical library at the Central Laboratory, Ottawa, contains 1,600 books, 1,500 volumes of periodicals and 1,600 pamphlets. Sixty-nine scientific journals are currently received by gift or subscription, as well as bulletins and other publications from all parts of the world.

The general herbarium of the division now comprises 16,500 mounted specimens of flowering plants.

A collection of 8,500 species of foreign and 1,400 species of Canadian seeds has been accumulated.

The mycological herbarium contains 10,000 specimens, 5,000 collected in Canada and 5,000 purchased from northern European countries.

Seven thousand specimens of wood-destroying fungi have been entered and indexed.

Outposts of Service

As mentioned at the outset, ten branch laboratories, located across the country, are devoting their attention to problems peculiar to their several districts. At Charlottetown, P.E.I., and Fredericton, N.B., diseases of the potato and turnip are given special attention. At Kentville, N.S., the laboratory deals largely with diseases of the various kinds of fruits. At Ste. Anne de la Pocatière, Que., general farm crop diseases are studied. The laboratory at St. Catharines, Ont., concentrates on diseases of horticultural crops. The prairie laboratories located at Winnipeg, Man., Saskatoon, Sask., and Edmonton, Alta., devote their attention entirely to the cereal and forage crops grown in that region. Two laboratories in British Columbia, one at Summerland and the other at Saanichton, study mainly the diseases of horticultural crops.

CEREALS

One of the leading arguments advanced in support of the establishment of a system of experimental farms was that the crop varieties introduced from other countries had become so numerous that it was impossible for the ordinary farmer to give them a proper trial. The location of experimental stations at carefully chosen points across Canada seemed imperative, and once they were established the testing of available sorts was naturally their first step in cereal work. It soon became apparent, however, that special methods would have to be employed if varieties adapted to Canadian conditions were to be obtained. This seemed particularly true of spring wheat as no variety had been found which ripened early enough to be grown with safety in Western Canada. The Red Fife then being grown on the Canadian prairies was of outstanding quality, but it could not be depended upon to ripen ahead of late summer frosts.

The Quest for a Perfect Spring Wheat

And so began the historic search for the "perfect wheat" in connection with which the northern steppes of Russia and the elevated areas of India received special attention. Seventy-four varieties of spring wheat, forty-nine of barley and eighty of oats were brought together for plot trial by 1889. The wheats included Ladoga, Gehun, Onega, Russian Chirka, White Fife, Bluestem, Hard Red Calcutta, Indian Kharachi, Pringle's Champlain, Assiniboia, Rio Grande, and Campbell's White Fife.

A wheat obtained from the Lake Ladoga region, north of what is now Leningrad, Russia, proved the most promising. Not only was it early and high-

yielding but in preliminary baking tests the quality appeared satisfactory. It was therefore distributed in three-pound bags to several hundred western farmers. While desirable in respect to field qualities, it proved under further tests to lack that peculiar strength of gluten so highly prized by millers at home and abroad.

While searching in foreign lands for an early-ripening wheat which should possess the high productivity and quality of Red Fife, Dr. Saunders and his assistants were also applying their knowledge of plant breeding in an attempt actually to *create* the desired type by crossing.

Plant Breeding Explained

Breeding in plants is essentially similar to animal breeding. In cereal grains, however, both male and female organs are found within *one* individual flower or spikelet in the head or panicle, whereas in the animal kingdom *two* individuals, each representing a different sex, are involved. By cross-breeding in plants, then, is meant simply the artificial carrying of the fertilizing element—the yellow dust or pollen—from the male organs (anthers) of one variety to the female organs (stigmas) of another, after removal of the male organs or anthers from

Wire enclosure used in the breeding work with cereals at the Central Farm, Ottawa.

the latter before they have emitted their pollen. The newly introduced pollen grains develop small tubes, one of which grows downward and finally reaches the embryo sac. Here it discharges its sperm or male cells which unite with the egg cells to form a mass containing the characters both of the plant furnishing the pollen and of the plant fertilized. This union of male and female cells is called fertilization.

By this relatively simple device of cross-pollination, or cross-breeding as it is usually called, it is possible to produce many distinctly different types, from among which may be selected those which combine the desirable characteristics of the parent varieties to the greatest degree.

Disappointing Results of the First Breeding Efforts

Ladoga was crossed with Red Fife and with a selection of it called White Fife, on July 19, 1889. It was a date destined to become of historic interest.

Out of the many combinations resulting from these first attempts, four strains were selected to which the names Preston, Stanley, Huron and Percy were given. While all four matured in less time than Red Fife none inherited its flour quality to a sufficient degree and none was ever grown extensively in the West, although considerable controversy was waged about Preston. Huron came to be a leading variety in Eastern Canada, where quality is not so important as in the West.

Two early introductions, valuable later in breeding work, were Gehun and Onega, both early but not very productive. Crosses between these produced some interesting combinations, the most outstanding of which was named Early Riga, eight to nine days earlier than Red Fife but not quite so productive.

The Birth of Marquis

In 1892 crosses made between the early-ripening wheat from India, Hard Red Calcutta, and Red Fife resulted in the birth of the world-famous Marquis.

Of all varieties produced thus far by the Dominion Experimental Farms, Marquis may be said to stand in a class by itself. No introduction to date has excelled previously existing varieties in so many characteristics, nor has any variety displaced so many others over so wide an area. Its introduction may be said to have overshadowed in importance any other single event in Canadian agriculture, for it undoubtedly marked a new epoch in the agricultural life of Western Canada.

Marquis was released for trial in the Prairie Provinces for the first time in 1907, and by 1915 it had taken the lead over all other varieties. This lead increased so rapidly that within ten or twelve years of its introduction it is credited with having occupied not less than 90 per cent of all the spring-wheat area in the Dominion. The popularity of Marquis was due to its ability to ripen from three to ten days earlier than Red Fife—depending on locality and season, to its greater strength of straw and non-shattering habits, and to its greater yielding ability and high baking quality. In the latter respect it is considered to be fully equal to Red Fife.

Still Earlier Wheats Needed

But the need for a still earlier wheat of good quality and yielding ability was felt in many districts. Breeding and selection work, therefore, continued apace.

Prelude.—Prelude was brought forth in 1913. It sprang from a cross made ten years previously between Fraser and Gehun, the former being from a cross made in 1892 between an early Ottawa hybrid called Alpha and Hard Red Calcutta. Prelude proved to be one of the most precocious varieties known and a producer of flour of good baking strength. It was, unfortunately, a light yielder, and never became prominent except in further breeding work.

Ruby.—A 1905 cross between Red Fife and Downy Riga, a selection of Early Riga, produced Ruby, which was distributed in 1915 and grown rather widely for a number of years. Five to ten days ahead of Marquis, Ruby was considered equal to it in baking quality; but its yield was not entirely satisfactory, except in the Red River Valley where, however, its unusual susceptibility to rust condemned it.

Garnet.—Another 1905 cross, between a selection of Preston and one of Early Riga, produced Garnet. This variety was made available to western farmers in lots of two and four bushels in the spring of 1926 and quickly came to occupy a considerable area.

Ripening with Ruby and yielding much better, although equally susceptible to rust, it soon came to displace the latter, as it did many of the other earlier introductions. In milling and baking quality it has never been considered the equal of Marquis, and therefore is not recommended for districts in which the latter may be depended upon to ripen without frost injury. As a result, Garnet has come to be restricted very largely to the northern sections of Saskatchewan and Alberta, where it is now grown extensively.

Reward.—One of the most interesting varieties produced by the division thus far is Reward, which came from a cross made in 1912 between Prelude and Marquis. In maturity and yielding ability Reward comes midway between the two parents, while in quality as measured by volume of loaf it ranks higher than either, especially when they are grown in the northern districts. This valuable characteristic is doubtless due to the relatively high protein content which it normally carries. Unfortunately, Reward does not compare very favourably in yield with other standard varieties except in certain districts to which it seems specially adapted; it therefore has not come to occupy as large an area as it otherwise would have done. In 1935, however, Reward, by giving better average returns in the rusted areas than did any of the other common varieties, gained many friends.

Further Crosses Promising.—While many new early-ripening hybrid types originating from crosses between such varieties as Reward and Garnet, Garnet and Marquis, Reward and Early Red Fife, Reward and Canus, and many others appear promising, only further tests can decide their value to Canadian agriculture.

Breeding Rust-Resistant Wheats

In 1916 an unusually severe attack of wheat stem rust, sweeping like a prairie fire across the waving fields of Manitoba and eastern Saskatchewan, caused losses running into millions of dollars. This tragic event marked the beginning of a renewed interest in the possibility of overcoming rust through the creation of resistant varieties and led to the establishment, in 1924, of a Dominion Rust Research Laboratory on land provided by the University of Manitoba, Winnipeg. There, highly trained cerealists and botanists have been striving to create varieties which combine disease resistance with high quality and satisfactory yielding ability.

Renown.—Although scarcely ten years have elapsed, hundreds of varieties capable of resisting rust have been produced. The most promising of these have been submitted to exacting co-operative tests. One, to which the name Renown has been given, has been singled out for propagation and distribution to western farmers; in 1936 approximately six thousand bushels of seed were produced and will be made available for sowing in the spring of 1937.

An editorial in an eastern paper comments upon the significance of this work:—

> "Nothing that the politicians have done or are doing, nor anything that they may do towards strengthening the position of the wheat producer, can, in the long run, compare in value with what has been accomplished by departmental scientists in developing wheat that is not affected by rust."

Apex and Thatcher.—Two other excellent rust-resistant varieties are being introduced to Western agriculture for trial. One, bearing the name Apex, was developed by the University of Saskatchewan; and the other, named Thatcher, was produced by the University of Minnesota. The introduction of these, as well as Renown, was approved only after very careful tests had been conducted on experimental stations of both Dominion and provincial institutions in the Prairie Provinces.

Drought and Insect Pests Present Problems

Certain wheat varieties or types appear better able to survive drought conditions than do others, although they are not all commercially satisfactory. Efforts are being made to combine, by crossing, the drought-resistance of the best of these types with the rust-resistance and yielding quality of others.

In parts of Saskatchewan and Alberta an insect known as the wheat-stem sawfly causes serious losses almost every year. The larva of this insect, working within the wheat plant, cuts through the stem a short distance above the ground and causes it to break over and fall just before harvest. Certain thick-walled varieties have been found, which, despire attacks by the insect, are able to remain erect; but as none of these meet the Canadian requirements of a high-class bread wheat, crosses have been made with some of the standard varieties in the hope of effecting desirable combinations. This particular undertaking was initiated by the branch station at Swift Current, Sask., in the centre of the most seriously affected area. Although results are not yet conclusive they are distinctly encouraging.

Breeding Work with Other Crops

Winter-wheat growing in Canada on an important scale is limited chiefly to western Ontario, where a number of excellent varieties are being cultivated. None, however, combines a high degree of winter-hardiness and disease-resistance with satisfactory yield and the particular quality most sought. Efforts to produce such a variety have been under way for some time at Ottawa, and have resulted in the creating of a number of very promising types.

While special effort has been concentrated on wheat breeding, an enormous amount of work has also been performed in an effort to produce better varieties of oats, barley, field peas, flax, and field beans. Superior varieties of all these crops have been created and distributed, although a disastrous fire in 1915 destroyed much breeding material and greatly impeded progress.

Oats.—Among the more important varieties of oats produced are a medium-early one called Legacy and two hulless varieties called Laurel and Liberty, the only hulless oats ever tested at Ottawa that were satisfactory yielders. A new rust-resistant variety, Vanguard, was introduced for seeding in the spring of 1937. Other more recent creations, notable chiefly for their ability to resist disease and lodging, are under investigation and will doubtless be heard of later.

Barley.—The most noteworthy varieties of barley distributed by the division thus far are Mensury Ottawa 60 and Charlottetown No. 80. Many other types of promise have been developed or imported and are being investigated with the hope of finding something of outstanding value. Among the imported types, one bearing the name Olli, obtained in Finland, is of particular interest because of its ability to ripen early and to yield well.

Of the many varieties of barley, none contains all the desired virtues. The best varieties are highly productive but lack in strength of straw, in quality for malting purposes or in ability to resist disease. Some of the newer types bear smooth awns and are very productive, but lack the quality desired by the maltsters. So in barley as in wheat and oats a breeding program is under way.

Peas.—Field peas in some of Canada are a crop of importance. A number of excellent varieties produced by the division have come to occupy a foremost place. Chancellor, Arthur, and Early Blue are now standard varieties wherever peas are grown.

Flax.—Considerable work has been done in seeking to develop a more desirable flax, especially of the seed-bearing type, and a number of varieties useful in themselves or for breeding purposes have been produced. Special mention may be made of Novelty, Diadem and 770 B. As recent tests have shown

that flax varieties differ inherently in their ability to produce quantity as well as quality of oil, the breeding program has been revised so as to take this important fact into account.

Field Beans.—Particular stress has been placed upon the development of early-ripening types of field beans suitable for use in northern districts, where the common varieties fail to mature satisfactorily. Such noted kinds as Norwegian Brown (Ottawa 710) and Beauty (Ottawa 712) have been developed.

Milling and Baking Tests

It is a far cry from the chewing test by which the quality of Marquis was discerned to the present method of judging quality by milling and baking small samples of new stocks in the cereal laboratory of the Central Experimental Farm. Now unsuitable strains are discarded before much work has been bestowed upon their propagation and testing, and likely ones are submitted to a close appraisal of their relative merits for bread, pastry or other uses. The cereal laboratory is an economical short-cut to success in breeding and experimental work.

Cereal Work on the Branch Farms

Splendid work is done by the Dominion branch farms and stations across Canada in the appraisal of new types. Obviously, a most exacting system of comparative field tests, such as that in vogue at these strategically located institutions, is imperative and must precede the introduction of a new variety. Of recent years not only do these branch stations determine the varieties worthy of distribution but they carry on an immense amount of selection work in the general breeding program. Plant populations either created at the branch stations themselves or supplied from headquarters at Ottawa are grown and observed at these places, and in due course are submitted to exacting selection work. This plan permits a study of an enormous number of types at many points throughout Canada, and provides the maximum opportunity for identifying varieties which should prove of greatest value to their respective communities.

Co-operation with Other Agencies

In the quest for new and better grains, close co-operation with provincial departments of agriculture, and with universities and colleges has been maintained wherever practicable. It has come to be the general practice to conduct all major tests co-operatively, and to pool the resulting knowledge. This, perhaps, is one of the major developments within recent years.

When tests finally prove the superior virtues of a new variety or strain, another organization, now over 30 years of age, is waiting to propagate it on a commercial scale and in a pure state. This body, known as the Canadian Seed Growers' Association, occupies a most important place in Canadian agriculture, and is assisted in its work in every way by the Cereal Division which it serves so well.

The Follow-Up Problem

And finally, there is the "follow-up" problem. Are these improved seed stocks being maintained in a reasonably pure state when they get out into general cultivation? Is this good seed being used as widely as it should?

The Crop-Testing Plan.—This particular problem is receiving special consideration in Western Canada by a unique body which came into existence only six years ago in response to an appeal from divisional officials. Comprising a group of prominent grain-handling firms, it sponsors the "Crop-Testing Plan", by which samples of grain are collected each autumn from thousands of farmers' wagons at country elevators and grown in small plots the following year, when

purity of variety is determined. Thus is the status of farmers' crops in large numbers determined, and the need for improvement ascertained.

Checking the Export Cargoes.—Other co-operative activities participated in by the division in recent years include the growing of samples obtained from export cargoes of the different contract grades of wheat annually collected by the Board of Grain Commissioners. The information obtained is of value in indicating the extent to which different varieties enter into commerce, and in showing the degree to which prescribed standards are being maintained in so far as varietal composition of the different grades is concerned.

Dominion Cerealist examining wheat plots grown from farmers' samples to determine their suitability for seeding purposes.

National Value of Improved Varieties

The national value, in dollars and cents, of improved varieties of cereals introduced by the Dominion Experimental Farms System to date would by difficult to estimate. Some conception, however, may be gained by a simple calculation of the financial gains realized by Canada as a result of the introduction of Marquis wheat alone. During the past 20 years the three Prairie Provinces have devoted an average of approximately 21,000,000 acres to wheat. Of this, Marquis has probably occupied at least 15,000,000 acres on the average, the balance being devoted very largely to varieties carrying the "blood" of this variety. These 15,000,000 acres, occupied by a variety which has proved capable of out-yielding old Red Fife by about five bushels per acre, will have produced each year approximately 75,000,000 bushels *more* wheat than they would have done had they been seeded to the latter variety. This huge annual increase resulting from the use of one variety alone represents a financial gain to the country many times the entire annual cost of the whole Experimental Farms System.

A further contribution, the value and far-reaching effect of which will be difficult to compute, undoubtedly will result from the introduction of the new rust-resistant wheats. When one recalls that the losses suffered by the western wheat crop in 1936 alone as a result of wheat stem rust have been estimated at

$85,000,000., and when it is realized that substantial losses are experienced on account of this disease *every* year, some idea may be had as to what these rust-resistant types may mean to the country. Not only will they remove one of the most serious hazards of the crop, but they will promote greater confidence in the industry and in the country as a whole. In all great battles, a strong morale is fundamental to success. There can be no doubt whatever that the money spent in the creating of improved varieties of field crops is invested wisely and well.

CHEMISTRY

The Division of Chemistry dates from 1886, when a small laboratory was established in the city of Ottawa. In 1889 the laboratory was transferred to the main building on the Central Farm. After a fire which destroyed the interior of the laboratory, a Chemistry building was erected, occupied in 1896, enlarged in 1913 and further enlarged in 1925.

The scope of the work in chemistry has been broad and practical. In recent years research in specific phases of agricultural chemistry has developed. Under the present organization there are laboratories for research in animal and poultry nutrition, plant nutrition, soils and fertilizers and food investigations; and service laboratories for the routine analysis of agricultural materials. Most of the projects discussed here were initiated by the first chemist in charge.

Agriculture as an industry depends primarily upon the soil for its profits; the soils of the Dominion and the measure of soil productiveness have therefore been the subject of considerable research in the laboratories.

Studies of Western Prairie Soils

One of the earliest investigations was a study of the chemical and physical composition of certain types of soils in Manitoba, Saskatchewan and Alberta. It showed that for the most part prairie soils are relatively rich in plant food and that of the three chief elements of fertility (nitrogen, phosphoric acid and potash) the soils are least rich in phosphoric acid. It was pointed out that the application of phosphates might in time be necessary for maintenance of production and for early maturity—a conclusion borne out by the beneficial results obtained from recent trials with superphosphate and ammonium phosphate. Later, studies of virgin and cultivated soils drew attention to the dissipation of nitrogen and organic matter from the cropped soil following continuous grain-growing and frequent summer-fallowing. Although these losses became less as the period of cropping increased, their detrimental effects on yields were considerably reduced by suitable crop rotations and cultural methods.

Classification of Irrigable Lands.—Soils of surveyed and irrigable lands of southern Alberta and southwestern Saskatchewan, the nature and concentration of whose alkali content might be doubtful, were analysed for a number of years. The information thus obtained protected the purchaser of irrigable lands and ensured him, under rational conditions of irrigation and drainage, against "rise of alkali". It had a national aspect since it prevented the destruction of certain areas which were capable of being successfully cultivated under dry-farming methods.

Soil Fertility Problems in Eastern Canada

Studies of soil series from the Maritime Provinces, Quebec and northern Ontario have shown that while many of the soils are somewhat below average in their content of plant food, they may be made highly productive by the intelligent use of fertilizers, manures and soil amendments. The soils of the Maritime Provinces are on the whole low in lime and are acid in reaction, requiring the application of lime compounds for the satisfactory growth of most

crops. A number of studies are being conducted at present with the object of correlating the balance of the plant-food elements of the soil with yields and physiological disorders of various crops.

Peat and Muck Soils.—Peat and muck soils occur extensively in certain districts of Canada. Their chief characteristic is a deficiency in mineral plant food—particularly potash. Burning the surface of the deposits to supply minerals for plant growth, as commonly practised in some sections, is wasteful and has been found unnecessary for satisfactory yields provided phosphatic and potassic fertilizers are applied.

Methods of Analysis.—Methods of determining the supply of nutrients available for plants during the growing season have received much attention by soil investigators. A number of rapid chemical methods developed for this purpose are under investigation by the division. Methods for the determination of trace elements in soils and plant materials by spectrographic analysis have also been developed.

The nitrogen laboratory of the Division of Chemistry.

Clover as a Fertilizer.—One of the most important investigations is that which demonstrated the fertilizing value of clover. It was found that a single crop of clover turned under would furnish an amount of nitrogen not less than would be supplied in ten tons of manure per acre and in addition would improve the tilth of the soil by increasing the humus supply and the moisture-holding capacity.

Barnyard Manure.—Experiments were undertaken to study the influence of food, of litter and of methods of handling and storing on the composition of manure. Manure piled loosely in the yard depreciates chiefly through the leaching of soluble nitrogen and potash compounds and partly through fermentation. In the course of a few weeks these losses may amount to more than one-third of the initial value of the manure; consequently from the soil-fertility point of view the sooner the manure is drawn to the field the less will be the loss of fertilizing constituents.

Investigations with Fertilizers

From the early days of its inception the Division of Chemistry has carried out many experiments in the field, laboratory and greenhouse to study the economic use of fertilizers in the production of farm crops. The field work has been conducted at the Central Farm, Ottawa, and at many of the branch institutions of the system. It was planned to ascertain the relative importance of applications of nitrogenous, phosphatic and potassic fertilizers on different types of soil and under various climatic conditions. The materials employed were chiefly those most commonly found on the market; nitrate of soda, sulphate of ammonia, cyanamid, dried blood, tankage, superphosphates, basic slag, muriate and sulphate of potash, and—of later years—nitro chalk, nitrate of lime, urea and ammonium phosphate.

In general, this investigational work has shown that in Eastern Canada it is good practice to employ a complete fertilizer mixture, and that the most profitable use of fertilizer is associated with an application of barnyard manure at least once in the rotation. In the Maritime Provinces particular attention should be paid to the application of lime and phosphoric acid in the growing of field crops.

More recent experimental evidence has emphasized that the uniform distribution and correct placement of the fertilizer with respect to the seed have a distinct bearing on the economical use of fertilizers.

It has been found within the last two or three years that elements other than those supplied by commercial fertilizers may seriously affect crop yields. Experiments to study the effects of minor elements such as boron, manganese, and magnesium have been instituted.

Animal Nutritional Studies

Soft Pork.—Firmness is one of the most important qualities for first-class bacon. A considerable proportion of pigs marketed have produced soft pork and this character of softness has been associated with swine from certain districts. Investigation to learn the nature and causes of softness and to suggest preventive measures occupied three years and involved the feeding of 300 pigs, the fat from which was subjected to critical chemical examination.

The conclusions were:

That the controlling factors in the firmness of the finished pork lie in the character of the food employed, methods of feeding and proper finishing of the hogs.

That Indian corn and beans tend to produce soft pork. If fed in conjunction with skim-milk, a considerable proportion of Indian corn may be used in the grain ration without injury to the quality of pork.

That a grain ration consisting of a mixture of oats, peas and barley in equal parts produces a firm carcass of excellent quality.

That skim-milk not only tends to thriftiness and rapid growth but counteracts in a very marked manner any tendency to softness.

That rape, pumpkins, artichokes, sugar beets, turnips and mangels may be fed in conjunction with a good ration with no injury to the quality of pork.

That fat of very young pigs and of animals of unthrifty growth is softer than that of pigs which have increased steadily to optimum weight.

Digestibility of Canadian Feeds.—No standards for digestibility of Canadian feeding stuffs are at present available, investigators being dependant on data derived from American and other foreign sources. The division with the cooperation of the Animal Husbandry Division, is now equipped to supply Canadian data. At the outset, studies have been conducted with cattle, particular attention having been directed to the values of roughages. Grains, commercial

feeds, and pasture herbages are also under investigation. The work will be extended to include hogs, sheep and poultry.

Tables giving the digestibilities of Canadian feeding stuffs for all classes of live stock will be the ultimate object of this work.

Vitamin Research.—Vitamin research is at present restricted to the study of the vitamin D requirements of poultry. Technique of a standard method for determining the vitamin D content of poultry feeding stuffs is under investigation and nearing completion. The successful application of this technique will protect feed manufacturers and poultrymen from fraudulent and extravagant claims.

Shorthorn steers in special stalls used in connection with studies of animal nutrition.

Plant Nutrition

Influence of Environment on Quality of Wheat.—Quality of wheat is largely determined by the character and quality of the protein. The quality of the protein appears to be chiefly an inherited factor but investigations extending over a period of 30 years have shown that the amount of this valuable constituent is largely determined by environmental conditions—chiefly precipitation, but temperature, hours of sunshine and soil fertility also play their part. Those environmental factors which hasten the maturation of the kernel and shorten the period during which carbohydrates are being synthesized in the wheat berry, assist in the production of high-protein wheat. It may be pointed out, however, that the character of the soil, in respect to its composition and capacity for moisture, is a factor closely associated with precipitation.

Sugar Beets.—Investigational work on sugar beets was begun in 1902 to ascertain the suitability of various districts in Canada for economic production

of sugar from beets and to determine what variety of beet was most suitable in any particular district.

The best and most constant results were obtained from beets grown in southwestern Ontario, the Maritime Provinces, southern Alberta and British Columbia.

Under modified form this investigation is being continued. Special attention is devoted to plot technique, and data are subjected to statistical analysis for correlation of sugar yields with varietal and environmental variabilities.

Close-Grazing Scheme of Pasture Management

In 1927 an experiment was planned to learn what effect cutting at intervals of one, two or three weeks had on the composition and yield of grass, and to compare the grass with hay and with aftermath. This was the first scientific examination in Canada of the German system of pasture management, a scheme which aims by close grazing and heavy fertilization to furnish highly nutritious grass throughout the season.

This enquiry has shown:—

The high protein content of young grass. One-fifth to one-quarter of its dry-matter content is protein.

The protein percentage of hay was less than one-half that of young grass.

The average protein yield in hay was one-fifth less than that in grass.

The digestibility of the protein of hay was much lower than that of grass. The digestible protein of grass was approximately 75 per cent greater than that of hay.

The close-grazing scheme, provided there is sufficiently distributed rainfall, furnishes throughout the season pasture rich in highly digestible protein.

Insecticides and Fungicides

Intensive studies of the majority of insecticidal and fungicidal products on the market have been made, in co-operation with the Entomological Branch, and the accumulated findings of this research paved the way for the passing of the Agricultural Pests Control Act. The operation of this act assures uniformity of product and adherence to guaranteed ingredients.

In the past, compounds of arsenic, lead and fluorine, in toxic quantities highly poisonous to humans have been largely used for insect control. The active principles of plants, such as derris and pyrethrum, quite poisonous to insects but relatively harmless to humans, have been studied. It has been shown that pyrethrum flowers of high potency can be grown in Canada.

Other Plant Investigations

Studies are being made of the chemical composition of fruits and vegetables and of the changes occurring in them during storage. Correlations of the composition of these products with the incidence of physiological disorders and with the fertilizer and cultural practices employed are under study.

Studies are being continued on the influence of environment on the composition of various strains of cereals, soybeans, native and foreign grasses.

Food Investigations

In 1908 these laboratories undertook control of food products made necessary by the regulations under the Meat and Canned Foods Act. This work has broadened to include the critical examination of canned foodstuffs of animal, vegetable or fruit origin prepared in establishments under Departmental inspection or imported from foreign countries. Since 1931 the regulations of the Maple Sugar Industry Act have been enforced by control in these laboratories.

Control includes the examination of finished products as well as of materials used in their preparation. Investigational work is undertaken to find out causes of spoilage and to improve products. Methods for the more accurate determination of the fruit content of jams have received attention, resulting in more efficient control. Various branding inks for use in connection with inspection and grading of animal carcasses have been evolved. Investigations with maple products have resulted in improved analytical methods for the detection of adulteration and the annual examination of numerous maple products protects the Canadian output.

ECONOMIC FIBRE

The outbreak of the European war in 1914 was mainly responsible for the establishment of a Fibre Division in connection with the Experimental Farms System. Belgium and Northern France, both producers of large quantities of flax fibre, were at that time in the hands of the German invaders and as there was a tremendous demand for linen and fibre for manufacturing aeroplane wings, canvasses, machine-gun strings and many other articles, some large unrestricted

Seed plots of pedigreed flax varieties in bloom at Ottawa.

source of supply had to be found. Many fields within the British Empire, including British East Africa, Australia, New Zealand and Canada, were scouted and Canada proved to be more suitable than the others for flax production. Even at that time, however, approximately 4,000 acres were already devoted to the growing of flax for fibre purposes in the Dominion.

The Fibre Division, organized in 1915, undertook to increase the acreage greatly by giving all possible assistance to prospective Canadian growers of flax and hemp. The publication of a war circular set forth the great need of linen for war purposes and pointed out how Canada could assist the Empire in creating an immediate source of supply of raw material. This appeal was received

with enthusiasm and as a result the area was increased to approximately 35,000 acres, principally confined to the provinces of Ontario and Quebec, the Prairie Provinces being found unsuitable for producing a fibre flax for export. Most of the fibre flax then grown was produced from what is known as the ordinary Blue Dutch variety.

During the recent depression the area dropped to as low as 5,000 acres, because of lack of demand in the Old Country for flax fibre. Russia was shipping in large quantities of fibre at prices with which Canada found it very difficult to compete, and prospects for Canadian flax growers became somewhat discouraging. The situation was saved for the growers because of the development of a splendid pedigree seed trade in Ireland. In addition, a market was discovered for the greater portion of flax straw as upholsterers' tow. This provided an outlet for the straw in the green broken state.

Marketing Pedigree Fibre-Flax Seed

In 1923 the Irish Department sponsored the development of a new variety of fibre flax known as J. W. S. Later, through the efforts of the Fibre Division, about 50 tons of seed were imported into Canada in co-operation with the Empire Marketing Board and Mr. W. J. Megaw, of the Ministry of Agriculture for Northern Ireland. This seed was allotted to the different flax growers free of charge, provided they returned, the following year, bushel for bushel of the progeny of the seed received.

Since that time several new varieties have been shipped to Canada for bulking. The more important were Stormont Gossamer, Stormont Cirrus, Liral Monarch, Liral Crown and Liral Dominion. The Liral varieties were originated by the Linen Industry Research Association of Lambeg, County Antrim, Northern Ireland and the Stormont varieties were developed by the Irish Department of Agriculture. The bulking of seed of these varieties for the export market has provided Canadian growers with one of the best-paying crops in the average farm rotation today.

Virtually the entire Canadian crop of both fibre and seed is sold each year through the direct assistance and guidance of the Fibre Division.

In the province of Quebec during 1930 the De Beaujeu Flax Growers' Co-operative Society was formed. This organization was operated, owned and controlled by farmers in the district. During its early years this young organization was given every assistance possible by the division. Some 300 acres were planted in that year and since then the area has so increased that flax has proved to be one of the major crops in Soulanges county.

Numerous established flax mills located in western Ontario have also received the same consideration and constructive advice as that given to the De Beaujeu Flax Growers' Co-operative Society. These mills have proved so successful, especially during this past few years, that other similar units are being planned for future development.

Experimental Work with Fibre Crops

After the old flax mill at Ottawa had been rebuilt in 1922 a more elaborate set of experiments was instituted than had been attempted up to that time. Both flax and hemp were included in the experimental plan, 30 projects being developed.

Twenty varieties are tested annually. Methods of seeding and dates of seeding are compared. The quantity to sow per acre has constantly been a problem on which opinions have differed. In Ireland, for example, the flax seed is generally sown at the rate of about two bushels to the acre. This produces a high yield of fibre but the seed yield has to be sacrificed to a certain extent.

The recommended rate of seeding flax in Canada is 84 pounds. This allows for a satisfactory yield of seed as well as a good yield of fibre. Experiments dealing with various rates of seeding under Canadian conditions are being continued.

Testing Seeds from Different Sources.—Seed of both flax and hemp from all over the world is procured and given a thorough test against standard varieties in the experimental plot field.

Applying Artificial Fertilizers.—The economic importance of artificial fertilizers for the production of fibre crops will, as the years pass, become more important. At present, satisfactory crops of flax may be secured on land that is of only medium fertility, but, on the other hand, hemp is very responsive to the application of commercial fertilizer. Over a period of years results have proved that the application of potash to flax definitely improves the quality and yield of fibre. It has also been shown, rather conclusively, that hemp responds very noticeably to the application of nitrogenous fertilizers.

Retting Tests.—Almost since the time flax became commercially important, attempts have been made to carry on both artificial and natural retting processes. All phases of retting are dealt with very accurately and carefully at Ottawa. Of recent years there has been a strong tendency to convert green flax straw by retting methods into a product known as cottonized flax. Excellent work has been accomplished in this process and the results are being carefully studied by the Fibre Division.

Tests of Machines and Methods

Every year new machines, many of which have not been tried out sufficiently to prove their efficiency under commercial conditions, are placed upon the market. The division, with its modernly equipped flax mill at Ottawa, serves as a clearing house for information because machinery can be given a rigid and unbiased test. Thus flax growers are not exploited by promotion companies.

Numerous enquiries concerning the bleaching of homespun linens are received. The call has been for a bleaching method that is simple, economical and effective. After a series of experiments a method has been developed by which home-spun linens may be bleached satisfactorily by very simple means. The method has been tried out in practice and has proved to be suitable for use throughout the farmers' wives' clubs in the province of Quebec.

Fostering the Development of the Industry

Each winter an expert from the division gives spinning and weaving demonstrations in the various centres where farmers' wives' clubs are established in the province of Quebec. The demand for this kind of assistance is increasing at a rapid pace; in fact it is difficult to comply with many of the requests received.

Another phase of extension work that is very favourably received is that of installing small commercial units for braking and scutching flax. The purpose is to encourage the better methods of handling flax for spinning and weaving purposes. A supervisor is sent to install the units—each of which is capable of serving anywhere from 100 to 150 farmers—and to give advice on the best methods of seeding, harvesting, scutching and preparing flax for the market.

Many demonstration cases of flax have been prepared for use in schools and colleges throughout Canada. In addition, lectures and demonstrations have been given at different educational institutions.

Canada is in a position to compete with most European countries so far as fibre production is concerned, and the future for flax seed production appears to be particularly bright. Moreover Canada is now recognized as one of the largest producers of pedigree fibre-flax seed within the British Empire.

FIELD HUSBANDRY

The function of the Field Husbandry Division is to conduct investigations on the various problems in field crop production. The division keep accurate records of all phases of this work so as to obtain definite information on cost of production. Meteorological data are collected and summarized from the different Dominion experimental stations throughout Canada.

The maintenance and increase of soil fertility is the subject of particular investigation on all the Dominion experimental stations. Experiments are designed to determine the value of farm manure, green manures, fertilizers and soil amendments and the most satisfactory rates and methods of applying them.

Manure and Fertilizers

The importance of maintaining the fertility of farm land by the regular application of manure or fertilizers has been demonstrated in several long-term experiments. At Ottawa, for instance, the average yield of mangels secured over a 24-year period in a rotation of mangels, oats, clover, and timothy, has been 8·22 tons per acre on unmanured land—and the yield has dropped to approximately 2 tons per acre in the latter years of the experiment. However, where 15 tons of manure per acre have been applied to the mangels the yield has averaged 22·46 tons, and where fertilizer has been applied instead of manure the average yield has been 20·74 tons per acre. Succeeding crops in the rotation have given similar, though less striking, differences in yield. Oats have shown less response to added fertility than the other crops in the rotation. These results indicate the serious decline in yield which may result if no fertility is returned to the soil for a number of years. They indicate, also, that both manure and fertilizers are effective in maintaining crop yields.

It Pays to Drill the Fertilizer with the Grain

In experiments with grain crops it has been demonstrated that more economical use may be made of fertilizer materials by drilling them in with the seed rather than by applying them broadcast. At Ottawa, drilling in fertilizer at 100 pounds per acre has been as effective as broadcasting it at 200 pounds per acre, while in the Prairie Provinces even more striking results have been secured. The best placement of fertilizer for silage corn and potatoes is in narrow bands on both sides of the seed at a distance of from one to two inches. It is interesting to note that modern fertilizer distributing machinery is being designed with correct fertilizer placement in mind.

Correct cropping and cultural practices, combined with the judicious use of manure and fertilizers, are essential in securing the maximum productivity of the soil. Extensive experiments are being conducted throughout Canada to determine the comparative values of rotational and continuous cropping for different crops, the correct sequence for rotated crops, and the best cultural practices for various crops in relation to the maintenance of soil fertility.

Enormous losses in crop yields are caused by weeds. In experiments conducted on several stations in Eastern Canada, reduction by weeds in the yield of oats has been found to range from 13·7 to 46·1 per cent of the yield secured on weed-free land. Similar losses have been experienced with other crops. In the Prairie Provinces where weeds are especially injurious through competition with crops for soil moisture, reductions in the yield of wheat of as much as 85 per cent have been found. When the greater cost of handling weedy crops is added to the losses resulting from yield reduction, it is obvious that the aggregate losses throughout the Dominion are very great and that improved methods of eradication are vitally necessary.

Methods of Weed Control

Successful eradication of annual weeds, such as mustard, depends largely on preventing the formation of seed which would reinfest the soil. This may be accomplished on fallow land and on inter-tilled crops by cultural methods, in hay land by mowing at suitable dates, and in grain by chemical sprays. Experiments have shown that without appreciable injury to the grain crops, mustard in grain can be completely prevented from going to seed by spraying at suitable periods with a three per cent solution of copper sulphate. Dusting grain crops with certain chemical dusts has been found equally effective and promises to be more economical, for the control of mustard in grain. Other methods have been found effective in the control of annual weeds. Harrowing when the grain is just emerging or only a few inches high has reduced the infestation of annual weeds by as much as 50 per cent without permanent damage to the grain crops; seeding grain at rates somewhat higher than is necessary on weed-free land has been found to retard the growth of weeds by subjecting them to greater competition, and applying fertilizer for grain in the drill row with the seed has proved beneficial by giving the grain an early advantage over the weeds.

Cultural Practices—Ploughing timothy sod in the summer, followed by fall cultivation (right) has given better control of weeds and much higher yields of corn than has ploughing in the spring only. (left).

Perennial-weed control includes cultural, cropping and chemical methods. After-harvest cultivation consisting of late-summer and autumn working of sod land has effectively controlled couch grass. Couch grass has also been eradicated by growing inter-tilled crops or smother crops for two successive years. These methods have also proved useful in eradicating perennial sow thistle. Extensive experiments have indicated that most perennial weeds may be destroyed with chlorate sprays, particularly sodium chlorate. This material, however, is too expensive for use on large areas, besides having injurious residual effects on succeeding crops.

The application of manure containing weed seeds is a common cause of weed infestation. Experiments conducted at Ottawa have indicated that the danger from this source may be avoided by rotting the manure before

applying it to the field. Where weed seeds are not present, however, it is preferable to apply unrotted manure. Experiments have shown also that the seeds of most of the common weeds are killed by ensiling.

Experiments in Silage Making

The production of silage for the provision of succulent winter feed and as an efficient means of storing green crops is an important phase of live stock farming. Experiments to determine the best methods of making silage have been conducted with some 19 different crops by the Field Husbandry Division at Ottawa for a number of years.

No difficulty has been experienced in ensiling such crops as corn, sunflowers, Jerusalem artichokes, mixed oats and peas, sweet clover, red clover, alsike, timothy and millet. Moisture content and stage of maturity were found to be important factors in the keeping quality of these crops. Considerable difficulty was encountered in ensiling alfalfa alone; but this crop was successfully ensiled when mixed with corn, timothy and other crops of relatively high carbohydrate content, and also by cutting the alfalfa in the full-bloom stage as is customary for hay and by treating it with molasses. Good silage was made from soybeans, but this crop is preferably used to raise the protein content of corn silage. Fairly good silage was possible with barley, buckwheat and kale, but the ensiling of these crops must be done carefully. Attempts to ensile hemp, prickly comfrey, mangel roots, and potato tubers proved unsuccessful. The potato tubers, however, were made into good silage by admixture with corn, alfalfa, or red clover.

Experiments have been conducted to learn the value of adding such substances as raw sugar, molasses and certain acids to various silage crops.

It is not suggested, of course, that all the crops which were successfully ensiled are suitable for silage. The ensiling of corn, oats, and peas, sweet clover, red clover and sunflowers is generally practicable, depending on the yields secured in different localities. Other crops which make good silage may be used for this purpose when weather or economic conditions make normal harvesting processes inadvisable.

The Field Husbandry Division has conducted extensive experiments throughout Canada to determine the best cultural, cropping and harvesting practices for the production of silage crops. The relation between the dimensions and capacities of silos has been investigated. With a total of 45,827 silos throughout the Dominion, silage production is a very important farm enterprise.

Pasture Investigations

In Eastern Canada it is estimated that over 12,500,000 acres of land are utilized for pasture. This area includes some 6,600,000 acres of improved pasture and 5,900,000 acres of natural, uncultivated pasture. The economical improvement of productivity on this large acreage of land affords an excellent opportunity of increasing farm revenues. With this object in view, the division has conducted experiments for a number of years on several stations in Eastern Canada.

On the comparison of rotated versus continuous grazing, the results, contrary to the accepted belief, indicate that the superiority of the former does not outweigh the expense of extra fencing and labour involved.

On old, permanent, native blue grass pasture the application of a complete fertilizer has considerably increased the production. A heavy application of superphosphate has also given good results.

Close grazing is essential to promote the growth of wild white clover, the most desirable of all pasture species. Clipping one-half to two inches high to simulate close grazing has produced consistently greater yields of herbage than

has clipping at higher levels. Sudan grass, of all the crops used as annual or supplementary pasture, has given, at Ottawa, the most satisfactory results. Where the climate is not so warm as at Ottawa, oats give fair results as an annual pasture. Annual pastures are useful during the summer when permanent pastures are likely to be short. Ploughing an old blue grass pasture, applying some manure or commercial fertilizer and seeding to a mixture of timothy, alsike and red clover has very considerably increased the production.

Soil-Moisture Investigations

The most important factor affecting crop production in the Prairie Provinces is the limited amount of soil moisture normally available. In order to determine the best methods of utilizing soil moisture, experiments have been conducted since 1922 by the Field Husbandry Division at Swift Current, Sask. In these experiments various crops have been grown in soil contained in water-tight tanks, so arranged that the amount of moisture present in the soil and used by the crops could be accurately determined. These experiments have resulted in many important findings regarding soil management under semi-arid conditions.

Soil Drifting Control—Strip-farming, or the production of grain crops in long narrow strips alternating with summer-fallow strips, is a very useful method of controlling soil drifting. Along with surface cultivation rather than ploughing, it is proving very successful.

In the Swift Current experiments it has been shown that the cultivation of summer-fallow land, apart from the destruction of moisture-consuming weeds, has little effect on the amount of moisture conserved. This finding modifies the theory that moisture is conserved by breaking up the capillary channels in the surface soil and thereby checking evaporation. Another interesting finding is that small increments in conserved moisture effect relatively large increases in crop yield, indicating the importance of even slight improvements in methods of conserving soil moisture.

Reducing the Losses from Soil Drifting

Soil drifting, or wind erosion of soil, has been the cause of serious losses in crop yields and severe permanent injury to soil fertility over extensive areas in the Prairie Provinces. With the object of controlling this menace to agriculture the division has instituted experiments at a number of points in the affected area. Control measures being investigated include strip farming, cover crops, surface tillage instead of ploughing, and other improved cultural methods.

The production of a rough, cloddy surface on cultivated land considerably reduces the susceptibility of soil to drifting. Control is also effected by the shallow cultivation of stubble land, particularly with the ploughless fallow which leaves as much of the plant residues as possible on the soil surface. A combination of the more desirable cultural practices with strip farming, in which the land is fallowed in strips of not more than 20 rods in width, has proved effective in the control of soil drifting. Methods which have given good results in areas receiving a fair rainfall are a light seeding of spring grain in the late summer on summer-fallowed land to produce a cover crop, and the inclusion of hay and inter-tilled crops in the rotation.

Cost of Production Studies

Records of the cost of producing farm crops have been kept on the experimental farms since 1890. In 1920 this work was expanded and systematized to secure comparative cost records for various crops. Cost-of-production studies have been made for grain-farming rotations and mixed-farming rotations. In the drier regions grain rotations have been found more profitable than rotations in which hay and silage crops have been included.

Farm Machinery Trials

The investment in farm machinery in Canada, according to the 1931 census, was $650,664,000. This represents 12·4 per cent of the total value of all farm property. The division has introduced and has conducted trials with farm machinery over a number of years. The first successfully operated combine in Western Canada was introduced by the experimental station at Swift Current, Sask., in 1922. The field ensilage harvester, which cuts standing corn and reduces its ensilage length in one operation, was introduced at the Central Experimental Farm at Ottawa in 1925.

Extensive trials with 12 different types of grain seeders in Western Canada have shown that the standard methods of seeding are as satisfactory as some of the newer combination methods developed in recent years.

The general-purpose or row-crop type of tractor has been found satisfactory for general farm operations in Eastern Canada. One tractor of this type can conveniently handle up to 75 acres of row crops in most seasons as well as the other tractor work on the farm.

The use of low-pressure farm-tractor tires has been investigated since 1933. It has been found that tires reduce the rolling resistance of a tractor by approximately 50 per cent, resulting in a saving in fuel, under certain conditions, of from 10 to 20 per cent.

FORAGE PLANTS

During the first 25 years, the Dominion Experimental Farms introduced and tested many kinds and varieties of grasses and legumes. With the rapid development of agriculture in all parts of the Dominion, it became evident that meadow, pasture and ensilage crops should be studied closely as a means of promoting the live stock industry and making the best possible use of both

cultivated and natural grasslands. The Division of Forage Plants was established, therefore, in 1911.

Improvement by selection and breeding may be regarded as the division's most essential work, but seed production, the blending of hay and pasture mixtures, the broad study of forage plant adaptation with special reference to meadow and pasture crops, experiments with turf grasses, and studies of certain special crops, the most important of which are soybeans and sugar beets, all find a place in the program of activities.

The breeding of forage plants adapted to Eastern Canada is conducted mainly at the Central Experimental Farm, the crops worked with most extensively being timothy, alfalfa, red clover, soybeans, corn, sunflowers, millet and field roots. Several species of grasses other than timothy are receiving some attention and the hybridizing of various species of wheat with certain perennial grasses has been undertaken as a special study.

Speeding Up the Work by Growing Crops Under Glass

The addition in 1932 of greenhouses well supplied with artificial-lighting equipment made it possible to mature the seed of most plants in the greenhouse during the winter months, and so to speed up the work by doubling the number of generations which can be grown in one year.

The office building, laboratory and greenhouses of the Division of Forage Plants, 1936.

At the branch laboratory established at Saskatoon, Sask., plant breeding is the major activity, with emphasis on the development of hardy and drought-resistant grasses and legumes for the West. The crops being worked with most extensively are alfalfa, sweet clover, brome grass, slender wheat grass and crested wheat grass.

The various lines of investigation on the branch farms and stations are closely co-ordinated. Variety tests, for instance, are standardized in such a way that the same varieties are studied on all those stations located in a major agricultural zone. When the results are brought together it is possible to arrive at definite conclusions as to the suitability of individual varieties.

Plant Introductions

The division maintains at the Central Farm a plant-introduction nursery which contains numerous species and strains from foreign sources as well as native species collected in Canada. Another comprehensive nursery, maintained at Saskatoon, contains species better adapted to the climatic conditions of the Prairie Provinces. Forage-crop nurseries are located also at almost all the branch farms and stations. Introductions are first tested either at Ottawa or Saskatoon, and if they show some promise they are sent to the branch farms to be further studied for their regional adaptation. Large savings are made for farmers each year by the timely study of plant introductions.

Superior lines of timothy resistant to rust have been isolated by inbreeding and selection, and the best of these have been recombined by cross-pollination to form an improved variety. In comparative tests at Ottawa, this strain of timothy has yielded more than commercial sorts, but elsewhere it has not been significantly better than some other improved varieties.

The agricultural value of brome grass for the Prairie Provinces was first demonstrated by the Dominion Experimental Farms. No other cultivated grass has contributed so much to western agriculture. A new strain has been developed recently by the division and named Parkland, indicative of its adaptation to the park belt of Western Canada. It differs from common brome grass in that the plants are dense and leafy, and do not possess the strongly creeping underground stems considered objectionable by many farmers. In 1936 about 700 pounds of seed were produced. Preliminary tests are promising and it is expected that in combination with alfalfa it will provide an ideal hay and pasture crop for the black-soil or park belt areas of the Prairie Provinces.

Crested Wheat Grass for the Dry Belt

Just as brome grass has proved to be so satisfactory a hay and pasture crop in the sub-humid parts of the Prairie Provinces, so crested wheat grass has been shown to be highly adapted to the semi-arid sections of southern Saskatchewan and Alberta. Extensive studies have been made at the Dominion forage crops laboratory, Saskatoon, and at the Dominion range experiment station, Manyberries, to determine the best methods of seeding down this species. The information thus obtained has had a timely and practical application in the large-scale regrassing program recently undertaken in connection with reclamation projects in the drought areas. The Division of Forage Plants has taken an active part, also, in making it possible for farmers to produce the seed of crested wheat grass in large quantities by making available a continuous supply of foundation stock seed of the Fairway variety.

Shortly after the experimental farm at Brandon was established, the first critical test of slender wheat grass, a species indigenous to Western Canada, was undertaken. The Superintendent was so much impressed with its possibilities that he had the seed multiplied and distributed. His judgment has been amply justified, for this grass has been long considered one of the best cultivated hay crops in the Prairie Provinces. Plant selection within the species was begun about 1920, and an improved strain was later introduced as a combined hay and pasture type under the variety name Grazier. Selection work on an extensive scale was continued at Ottawa for several years, the best strains being sent for testing to western branch farms. Three of these selections have been outstanding at Scott, Sask., and seed is now available for distribution.

In recent years improvement work has been undertaken with the blue grasses, fescues, orchard grass and many other species.

Growing Our Own Alfalfa Seed

The Dominion Experimental Farms have been instrumental in establishing the superiority of the Grimm and the Ontario Variegated varieties of alfalfa for

Canadian conditions. New varieties and strains of alfalfa have been introduced from time to time, but comparative tests have shown many of them to lack winter-hardiness. Encouragement has thus been given to the use of Canadian-grown seed of Grimm and Ontario Variegated, with the result that Canada has been virtually self-supporting for several years past with respect to seed supplies of adapted varieties.

Alfalfa breeding has been given much attention. Good progress is being made in developing a winter-hardy, one-cut alfalfa for Western Canada, and types that are better adapted for pasture purposes. The latter would be especially valuable, and an attempt is being made to select pasture types that are low-growing and self-propagating by means of underground stems.

An Improved Red Clover

Red clover continues to be by far the most important leguminous crop grown in Canada. Because large quantities of red clover seed have to be imported from time to time, very extensive studies have been conducted by the division to determine the relative value of imported seed from various sources. Improvement of red clover has been accomplished by mass selection within the best home-grown material. This has resulted in a very hardy and productive strain which has outyielded other varieties in tests at Ottawa. Seed of this strain has been multiplied and placed in the hands of good growers for further production. An important feature of this work is the conservation of indigenous material.

Excellent progress has been made in developing fine-stemmed, leafy types of sweet clover adapted to Western Canada. Hybrids between the dwarf variety Alpha and other larger-growing sweet clover types appear to be very promising. Recent studies indicate that it will be quite possible to produce a variety that is not bitter to the taste and also varieties whose seed will not need to be scarified.

Breeding for Better Corn Varieties

Much attention has been devoted to the study of corn varieties and a classification of varieties and strains has been based on maturity groups. Corn breeding is conducted at the Central Farm and at the Harrow station in western Ontario. Selfed-line breeding with subsequent crossing is the method of improvement which has been followed. A number of selections, selfed-line hybrids and varietal crosses are being studied. Selection work on western branch farms has resulted in the isolation of early-maturing and productive strains of six different varieties of flint and dent corn. These are especially adapted to western conditions, and have been accepted for registration by the Canadian Seed Growers' Association.

There is a constant demand for information on the most suitable annual hay crops. As annuals are used extensively for pasture, cereals and other annual crops have been tested alone and in mixture for hay and pasture, both in experimental plots and under field conditions.

An early-maturing variety of Proso millet has been selected from material introduced from Manchuria. This strain produces a higher yield of seed than any other variety of millet grown in Canada and is distinctly superior in hay quality to commercial varieties of this type which are commonly used.

Soybeans—An Early Strain

A strain of Mandarin soybeans which is very productive, yellow-seeded and sufficiently early to produce excellent crops of seed at Ottawa has been developed by selection. More than 500 bushels of registered seed were produced in the Ottawa valley in 1935 and about 1,600 bushels, in 1936. Numerous tests in Quebec and the Maritime Provinces have been conducted, many of which were

successful, but still earlier varieties are required to provide a margin of safety. A new Ottawa selection ten days earlier than Mandarin, will soon be ready for distribution.

Large numbers of soybean introductions have been tested at Harrow since 1923 and at Ottawa since 1928. Approximately 600 hybrid strains are grown at Ottawa annually. The majority were obtained from crosses between the varieties Mandarin and Manitoba Brown, the hybrid selections being now in the sixth generation. Other hybrid combinations made at later dates are in process of selection. These strains are very early in maturity. Some are as early as Manitoba Brown, but the most promising are about 14 days earlier than Mandarin. Some are taller than Mandarin and give promise of yielding better. All are yellow-seeded.

Breeding nursery of forage plants showing soybeans with corn in the background.

Field Roots

A bulletin reprinted in 1934 discusses the methods of breeding which have been adopted with swedes, mangels and carrots, deals quite fully with seed production and presents a classification and description of types and varieties of field roots offered for sale in Canada.

The breeding work has made available improved strains of Yellow Intermediate mangel and Purple Top swede turnip. The former is superior in yield and dry-matter content, and the roots are uniform in type. The Purple Top swede turnip is a smooth root of good table quality.

A Swede Resistant to Club-Root

The growing prevalence of club-root disease of swede turnips, especially in the Maritime Provinces, is a serious problem. If the roots are severely affected the crop may be partially or wholly destroyed. Seed of a partially resistant strain of Bangholm, known as the Christensen Selection and originally introduced in 1923 by the Division of Forage Plants, has been distributed annually for a

number of years by the farms at Nappan and Charlottetown. In extensive tests conducted during the past three years in co-operation with eastern branch farms and illustration stations, the most resistant material was found within the Wilhelmsburger variety, but certain strains of Bangholm also were found to possess considerable resistance. Elite seed of a registered strain of Wilhelmsburger is now being produced at Nappan. This seed will be supplied, sealed in the sack, to registered growers for seed-production purposes.

At Ottawa and ten branch stations, 12 varieties of sugar beets have been tested. Included in the test were several standard sorts and a number of recently improved strains from different countries, some of which are bred for high sugar content. Data are available for three seasons on yield of beets, percentage of sugar and yield of sugar per acre. A study is also being made of sugar-beet-seed production at each of these locations.

Turf Grasses

Plots of grasses suitable for lawns and also fine turf for golf courses are maintained from year to year under suitable conditions to test their relative value and to study their behaviour under different systems of management and fertilizer treatments. Stolons of the best strains of bent grasses have been grown annually and distributed in small quantities to various sporting organizations that desire to multiply the grass for their own use.

Pasture Investigations

Pasture improvement is considered in many quarters the most important production problem in agriculture today. Comparisons of pure species and pasture mixtures from the point of view of productivity, nutrient value and palatability are conducted extensively in field plots clipped to simulate grazing and also in small fields grazed by dairy cattle and sheep.

Conservation of the native vegetation on the range in Alberta and Saskatchewan is the main objective of studies which have been made at the Dominion range experiment station, Manyberries, Alta. The results of these investigations are reported in the section dealing with that station.

HORTICULTURE

At the time of the inception of the Experimental Farms System there was a great lack of information on the adaptability of varieties and kinds of horticultural materials to various parts of Canada. Some of the more favourably located areas, such as the Annapolis valley and Niagara peninsula, had already developed a fairly satisfactory horticulture by the introduction of varieties from other countries, but the more remote parts of Eastern Canada and the Great Northwest were still in search of starting points in many horticultural crops. The early years of this division were largely spent, therefore, in variety testing and plant improvement through breeding and selection.

Research and experimental work in horticulture is now being conducted in several directions, and is organized, for this purpose under the following sections: pomology, vegetable crops, ornamental horticulture, plant physiology and nutrition, cold storage, and fruit and vegetable products.

Fruit Breeding Projects

As the Central Experimental Farm is not located in a favourable fruit area, attention has been centered around those fruit crops capable of development in the more severe regions. This necessity has eliminated work with peaches, sweet cherries, apricots, etc. The fruit districts of eastern Ontario and Quebec, and the more severe parts of northern Ontario and the prairies, are largely

dependent upon the creation of newer varieties of tree fruits. This is of real commercial importance in eastern Ontario and Quebec and of primary economic importance in the Great Plains, where the creation of a satisfactory horticulture is essential to a permanent civilization.

The apple-breeding work has been divided into two main divisions: (1) the origination of varieties suitable for eastern Ontario and Quebec, and (2) the origination of varieties suitable for the Great Plains. The early origination work consisted very largely in growing open-pollinated seedlings of varieties like McIntosh, Spy and Wealthy which had been pollinated presumably by hardier

Apple tree nutrition plots where trees are grown under controlled conditions to determine their reaction to varying plantfood requirements.

Russian varieties. Controlled crosses in which both parents were known, were later attempted, and this system has been in constant use in recent years, much of the work being performed under glass with trees grown in pots. As a result of this effort more than 10,000 seedlings have been fruited since 1887, and 330 varieties have been selected as worthy of further trial. McIntosh has proved to be an outstanding parent and has produced a very large percentage of varieties of promise. Ten varieties of apples have already been introduced commercially and have exhibited a high degree of hardiness during the test winters of 1933-34 and 1934-35. Of these, Melba, a very high-quality summer apple; Hume, an early-autumn; Lobo, a late-autumn; Lawfam and Sandow, two winter sorts, are probably the best known.

Hardier Apples for the Great Northwest

The origination of a line of apples for the Great Plains has steadily progressed since its inception by the late William Saunders 50 years ago. The first approach was through the crossing of the small Siberian pea crab, *Malus baccata*, with such hardy sorts as Tetofsky, Wealthy, McIntosh, etc. As a result of this first effort a line of crabs was originated which have proved to be hardy enough for the Prairie Provinces. Among these first crosses two, Osman and Columbia,

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were of outstanding value, and these are probably the hardiest crabs of their size and quality yet tested. By back-crossing some of the first crosses with varieties like McIntosh a line of second crosses was established, and, from among these, several have proved to be of superior hardiness. These are Piotosh, Rosilda, and Trail, and they mark a distinct improvement in really hardy varieties. Although still crab-like, they are of fair size, up to two and a half inches in diameter, with so little astringency as to make them palatable for eating out of hand.

Within the last four years a group of third hybrids, resulting from the crossing of these second crosses with McIntosh, Wealthy, etc., have been fruited, and these have to date exhibited a very high degree of winter hardiness. As many of them are full commercial-apple size with a considerable degree of quality, so that they are more like regular dessert apples than crabs, it is quite evident that by two stages of back-crossing there is a distinct possibility of combining the hardiness of the Siberian crab with the quality of apples like McIntosh and Northern Spy. This particular line of breeding work, in addition to providing hardy material for the Great Plains, may well prove to be the final approach to more permanent fruit varieties for those parts of Eastern Canada where extreme hardiness is a highly desired character.

The original *Malus baccata* (formerly *Pyrus*) tree used by Dr. Saunders is still standing on the main lawn of the Central Experimental Farm at Ottawa, marked by a brass plaque.

Breeding work is also being conducted with pears, cherries, plums and small fruits.

Other lines of work to which attention is being paid are rootstock and scion relationships, hardy frameworks and propagation methods.

Useful New Varieties Result from Vegetable Breeding Work

The vegetable section has made distinct contributions in new varieties of sweet corn, tomatoes, egg plant, peas, rhubarb, and strains of beets and onions.

Corn.—In the early years, early-maturing varieties of sweet corn were unknown. The Great-Plains region was largely limited to the use of the varieties left by the Indians, termed "Squaw" corn, an early but flinty type, not particularly pleasing according to modern standards.

The division has pioneered in earlier varieties of sweet table corn, and has contributed much to the consumer and the plant breeder by its introduction of Early Malcolm, Pickaninny, Banting, Dorinny, and Goldban.

Beets.—Selection work with the Detroit Dark Red variety has resulted in the establishment of a very superior strain of uniform colour and type. The seed, now eligible as Elite stock through the Canadian Seed Growers' Association, is being multiplied for general distribution through that organization.

Peas.—To meet the demand for a very small-seeded, wrinkled pea, similar to the *petit pois* of France, work was undertaken that has resulted in the production of the smallest-seeded wrinkled variety now on the market. This variety, named Tiny, contains on the average 500 peas in one ounce of dry seed. When canned the product is considered superior to the imported *petit pois* for colour, tenderness, and flavour.

Engress, another new introduction, is a vigorous, early-maturing, large-podded and large-seeded pea. It combines the large-podded and large-seeded characters of Laxton Progress with the earliness and prolific character of English Wonder. It has exhibited special promise as a satisfactory variety for freezing.

Rhubarb.—Ruby rhubarb, introduced by the vegetable section of the division, has had widespread distribution. On account of its remarkable colour and very

superior quality it has undoubtedly done much to increase the demand and popularity for this product. In addition to being used for outdoor growing it has been employed commercially for forcing purposes.

Tomatoes.—A valuable list of early-maturing varieties that are particularly useful for first early-crop production and for growing in regions where long-season varieties do not succeed, has been made available to the gardeners of Canada. The first introductions of note include Alacrity and Herald, followed by Abel, Bestal and Globonnie. The former two varieties proved their value as heavy, early-producing sorts—particularly in the short-season regions—and have found an important place in the early-crop areas as well. Abel has been found to mature fruit in 95 to 103 days from seed sowing; it is a heavy producer of medium-sized, high-quality, smooth, red fruit. Bestal, a very near approach in shape to Bonny Best, matures in the season of Earliana. Its value has been proved by repeated tests throughout Canada and in the United States. Globonnie is a mild-flavoured, red-fruited, Livingston Globe type, which combines the qualities of Livingston Globe and Bonny Best and matures in the season of the latter variety.

Origination of New Varieties of Ornamentals

Breeding work with ornamentals has resulted in the introduction of improved varieties of several plants.

Varieties in a new line of geraniums, named after the Ministers of Agriculture, are distinct acquisitions as pot plants. A few of the most outstanding are: Montague Purple, Carling, Angers, Crerar, Burrell, Tolmie, and Motherwell, with the addition of Elspeth, Sir Douglas Haig and Logsdail.

Part of the ornamental grounds at the Central Farm, Ottawa, showing a walk bordered with lilacs and irises.

In greenhouse plants several chrysanthemum originations of the division are of outstanding merit, such as J. R. Booth, a large exhibition type yellow; and Willingdon, a large single bronze. Among the bush types; Patricia Macoun,

Ella Sutherland, Catherine Motherwell, Mary Alice, Constance McKee, and Mary McKee are outstanding.

As imported lily bulbs are difficult to establish in gardens, it was decided to grow as many species as possible from seed. Twenty-three species, besides several varieties and hybrids, have been raised. Many crosses have been made between species in order to obtain new forms and hardier strains.

As roses that will be hardy without protection in the cold districts of Canada are very desirable, crosses have been made with this object in view. Some attractive bush roses have been obtained from several inter-specific crosses as represented by the Agnes, Grace, Cree and Huron roses.

The object of the work with irises was to obtain a large white iris similar to the Oriental iris Snow Queen with the tall stem of the Siberian. Crosses were made between these two sorts, and the outstanding seedlings of this cross are Gatineau, which received honourable mention by the American Iris Society in 1933; and Ottawa, which received an award of merit from the Royal Horticultural Society, London, in 1928.

Plant Nutrition Studies

The economic feeding of horticultural crop plants is a problem of the utmost importance to all growers. A study has been undertaken of several plants under controlled conditions to determine the symptoms shown by plants suffering from malnutrition. As a result of these researches, information of value in diagnosis has been obtained. Many coloured slides and coloured drawings have been accumulated which indicate these symptoms for strawberries, raspberries, apples, chrysanthemums, turnips, tomatoes, lettuce and potatoes Optimum nutritional ratios for most of these plants have been established, and these, together with the symptomatic diagnosis results, have been employed in making fertilizer recommendations for commercial practice.

Learning the Food Requirements.—Closely related to this work have been the studies in connection with the physiological disorders associated with nutritional conditions. Thus brown-heart of turnips has been found to be due to a boron deficiency; blossom-end rot of tomatoes has been found to be associated with an excess nitrogen condition, particularly in short days; cork troubles with apples have been associated with excess nitrogen conditions and have been corrected by reducing the nitrogen supply, or by adding boron to the feeding solution or by injecting it into the tree. Excess lime has proved to be another factor inducing the occurrence of these disorders—whether by tying up some of the minor elements or by increasing the availability of the phosphorus is not known. The close relationship between potassium and nitrogen has been fully established, and evidence of the possibility of inducing potassium deficiency by excess applications of nitrogen, phosphorus, and calcium has been obtained. The possibility of growing certain greenhouse crops in pure-sand cultures as a commercial practice has been demonstrated, chrysanthemums and carnations being particularly adaptable to this method. Exceedingly superior carnations have been obtained in sand, surpassing those grown in the orthodox manner, with virtually no addition in cost.

Cold Storage and Fruit Products

The division has operated since 1931 a small cold-storage plant in which experiments with the cold storage of fruits and vegetables have been conducted. The data collected have indicated the marked effect of nutrition on keeping quality. Proper nutritional balance has been shown as essential to good keeping.

In the fruit-products laboratory a method of manufacturing sweet and fermented cider has been developed which makes it possible to obtain complete

sterility of the product without using preservatives or excessive heat, which destroys its palatability.

Investigations with frozen fruit and vegetables have resulted in the commercial application of freezing to strawberries, raspberries, asparagus, and peas. Other crops, like spinach, beans, and corn, are about ready for commercial trial. This phase of work has been considered highly important to the fruit and vegetable industry as a means of promoting the use of surplus crops and as an aid in stabilizing the fresh fruit and vegetable market.

ILLUSTRATION STATIONS

The Golden Jubilee of the Dominion Experimental Farms marks the twenty-first year of the life of the Division of Illustration Stations. This came into being as a result of recurring crop failures caused by droughts that visit parts of the plains area in Saskatchewan and Alberta. At first the plan was to rent a certain portion of an interested farmer's publicly placed farm and to lay this area out into fields, so that a systematic rotation of crops, using suitable seed and judicious cultural methods, might be followed and then to direct the attention of neighbours in the community to this illustration station in the hope that they might emulate the work being done there.

At almost the same time as in the West, illustration stations were located in the East to feature the problems linked with soil fertility, cultural procedure crop rotation, varieties best suited to grow and crop adaptation.

Gradually new territories were included until each of the nine provinces came within the scope of this work. The order of establishment within the provinces was: in 1915, Saskatchewan and Alberta; in 1916, Quebec; in 1920, Nova Scotia and New Brunswick; in 1921, British Columbia, and in 1923, Prince Edward Island, Ontario and Manitoba. From the original policy of having a chief supervisor with supervisors over districts, a closer tie-up to the branch farms and stations was made in 1922. The district supervisor, since 1922, has been an assistant to the superintendent of the farm or station to which attachment was made.

In 1935 the drought and soil-drift problems of the prairies assumed major proportions, and in the endeavour to mitigate them the illustration stations of the plains areas were expanded into district experiment sub-stations. Upon these sub-stations the entire farm up to 640 acres was contracted for, and strip farming, tree planting, water-holding projects, and forage-crop production were featured.

In 1935 there were 184 illustration stations, and 39 district experiment sub-stations. The latter operated under the Prairie Farm Rehabilitation Act, but in part were a divisional activity, so that 223 districts received attention.

Farm Organization and Development

In the program of farm organization and development, the sale of live stock and dairy products constitutes the principal source of revenue on 115 of the 184 illustration stations and on the 39 district experiment sub-stations. On the remainder, specialized grain farming, including the sale of wheat, oats, and barley, is the chief source of farm income. On many of the 115 stations, particularly on those that have been in operation for a long time, well bred high-producing herds now appear, on others the number of milch cows kept is small in proportion to the size of the station. Because of the limited number of live stock maintained on many farms and the resulting relatively low production, the cash return is often inadequate to meet living expenses, taxes, and other necessary expenditures. Hence, on the illustration stations the aim is to develop sufficient revenue from the sale of milk, beef, pork products, poultry,

or cash crops, such as cereals, grasses, and clovers, to meet the necessary operating expenditures, which include comfortable support of the home on the farm.

When an illustration station is established, the first essential is to develop a crop-improvement program to systematize the work by establishing a rotation that is adapted to the district and that will provide the necessary feed for the animals kept. The next objective is to develop an improved herd which will

Home of an illustration station operator showing the well kept buildings and neatly planted grounds.

incidentally become a source of breeding stock for the community. Pure-bred qualified sires are used in the breeding phase of this work and dairy records enable the low-producing females to be weeded out. During 1936, operators distributed 235 head of cattle, 158 sheep, 496 swine, and 89 foxes for purposes of reproduction and 738 cockerels, 893 pullets, 2,608 sets of hatching eggs, and 3,150 baby chicks went out to neighbouring farmers.

Progress in Quality and Type of Wheat

With 83 illustration stations located in the Prairie Provinces, growing wheat has always been a major activity of the division. The original plan of cropping for prairie stations was chosen with such foresight that two of the crop sequences then included have not been superseded in general practice. Thus these stations afford a continuity of records in wheat production obtained under the best known crop procedure.

Further, those responsible for the introduction of the work appreciated the important influence of precipitation, and a rain gauge was provided as standard equipment for operators who were situated where rain was at times scant. These attentions have placed the stations in a unique position for records, records which go back for a number of years in many localities. Outside bodies such as the Drought Area Commission for southeastern Alberta, the Lethbridge Northern Irrigation Commission, the Empire Trade Conference, and others have had recourse to these authentic records on the growing of wheat.

For a decade the policy has been followed of supplying an operator annually with a small amount of registered seed wheat as a nucleus from which to build up in quality and uniformity his seed stock and the resultant wheat output. The extending benefit of this policy is felt over many districts of the Canadian

portion of the Great Plains region, and in the sections of Canada where wheat unmistakably belongs, it is kept well in the foreground. For the 1935 crop year 1,308 farmers bought 42,044 bushels of cereal seed from operators of illustration stations.

Pioneering in Legume-Seed Growing

Pioneering in the production of legume seed, such as red clover, alsike, sweet clover, and alfalfa, has been the role of illustration stations in many districts. Not until after the establishment of the work in 1916 was red clover seed produced commercially in the province of Quebec. In 1917 clover was threshed for seed on the illustration stations at Aubrey, Stanbridge East and Ste. Julie. As activity became more generally adopted the work was extended to other stations in Quebec and eastern Ontario. During the intervening period a study has been made of the necessary cultural practices, and red clover seed growing is now an accomplished fact on illustration stations in Nova Scotia, New Brunswick and British Columbia. Two years after the original start was made the operator at Aubrey harvested 2,700 pounds of red clover seed. The same year the secretary of the Aubrey Farmers' Club reported that $40,000 worth of seed was grown in the district and sold co-operatively through the club.

At Eriksdale, in the inter-lake area of Manitoba, the operator has won placings for sweet clover and alfalfa seed at the International Grain and Hay Show, Chicago; the Royal, Toronto; and the World's Grain Show, Regina. Prior to the beginning of illustration station work at Eriksdale in 1926 neither sweet clover nor alfalfa had been grown on the operator's farm nor in the district.

On the illustration station at Baldonnel, in the British Columbia portion of the Peace River district, alfalfa has been a particularly successful crop from the standpoint of both seed and hay production. This station, along with three on the Alberta side, sold from the 1934 crops over 6,000 pounds of sweet clover and alfalfa seed, thus affording an additional source of revenue.

Since the commencement of work in British Columbia the farm production of forage crop seed as a result of trials conducted on the illustration stations has steadily expanded so that now the sale of seed crops such as red and alsike clover provides a remunerative cash return. In 1936 the operator at Salmon Valley threshed over 8,000 pounds of alsike seed, and from the Prince George district over 90 tons of alsike seed were sent into commercial channels, the greater portion of it being shipped to Eastern Canada.

The production of forage plant seeds is carried on in 11 out of 13 supervisory districts of illustration stations across Canada.

Field Days and Co-operative Efforts

It is essential that the crops grown, the methods adopted and the results of fact-finding projects be brought to the attention of surrounding farmers. Field days held on the stations and, where possible, organized in co-operation with the local agricultural society, farmers' institute or agricultural representative, are a means used to attain this end. Attendance at these field days has steadily increased. During the 1936 season 147 meetings were held, with a total attendance of 16,149 people or an average of 110 persons per meeting.

The development of home orchards is a feature which is being given greater attention, the idea being to provide as far as possible within the farm unit an adequate supply of apples, plums and small fruits for home use. Started in Nova Scotia some nine years ago this project has proved very successful. Several of the earlier varieties have now come into bearing.

In co-operation with the Dominion Horticulturist a study is being made as to the hardiness and adaptation of new varieties resulting from the breeding trials conducted on the experimental stations. From the standpoint of informa-

tion this work has also proved valuable in the Prairie Provinces, particularly in Manitoba, where it has been developed over a longer period than in Saskatchewan or Alberta.

While illustration stations are primarily concerned with problems relating to crop and live stock production, the possibility of developing and maintaining attractive home surroundings and adequate buildings is given due consideration in progress plans. On many stations shelter belts, hedges, shrubbery, lawns, perennial and annual flower borders are being evolved for the purpose of illustrating what varieties are best suited to a locality and how they can be planted most effectively.

Field day at the illustration station with visitors examining the experimental plots.

Building plans for new barns, other out-buildings, and homes, as required, are discussed with the operators. Improvements such as the laying of cement floors, the provision of more and larger windows in farm buildings, and the installation of sheep-dipping tanks receive attention.

Efficiency in production, enhanced quality of output, together with additional convenience and comfort for living on the farms throughout Canada, are the objectives of the illustration stations.

POULTRY

Poultry work was begun in 1887. As the Central Experimental Farm was for a considerable time the only station in Canada where government poultry work was being conducted it exerted no small influence upon the early development of the industry.

The first artificial-incubation work on this farm was done in 1897, when a 100-egg machine produced 28 living chicks from its first hatch. The diseases in chickens reported at that time were roup and tuberculosis, and in turkeys a trouble developed that afterwards proved to be "blackhead".

In 1895 interest developed in the English market as an outlet for Canadian poultry produce. From then on for several years Canadian milk-fed poultry made a reputation on the London and Liverpool markets. In 1907 the division

was responsible for the introduction of the cotton-front poultry house, which has done more to revolutionize poultry housing in Canada than any other type of house.

In April, 1913, the organization at the farm was given the status of a division and its scope was extended throughout the Experimental Farms System. At present 24 branch farms and stations are engaged in poultry work. The study of diseases was taken up more definitely in 1922, when a pathological laboratory was equipped.

The earlier years were taken up largely with demonstrations of correct practices and with supplying quality stock to an industry which was in its infancy and growing rapidly. With firmer establishment of the industry and increasing amounts of equipment, a demand for the answer to many problems became apparent and a plan of research was embarked upon.

Incubation Investigations

One of the outstanding results of investigation in natural methods of incubation was the discovery of the dangers of using blue ointment for the destruction of vermin on setting hens. The mercury in the ointment not only kills the vermin on the fowl but also destroys the embryo in the egg on which the fowl is sitting.

Brooding chicks at the Central Farm, Ottawa. The chicks are brooded on clean range and never come in contact with old birds or land over which old birds have run, until they are brought into their winter quarters.

In artificial incubation the most satisfactory levels of the relative humidity were determined. These vary according to the type of machine used: for still-air machines, the type commonly used for farm operations, 60 per cent relative humidity may be accepted as most suitable. It has also been established that frequent turning of the eggs during incubation rather than turning twice a day as formerly recommended, improves the hatch.

The most satisfactory methods of brooding and rearing chicks under the conditions met with in what is a rather severe climate during the brooding period have been investigated. The effect of different brooding practices upon the control of disease has of necessity been an important part of this work. Brooding in large permanent brooder houses with cement runs was contrasted with brooding in colony houses upon clean range.

The Battery System of Brooding

In recent years an entirely new system of brooding chicks, known as the battery system, has been introduced to the industry. In this system chicks are brooded in wire-enclosed trays in a frame or battery to which heat is supplied either by heating elements in the battery itself, or by heating the room in which the batteries are kept. This system was compared to the systems of brooding in general use up to that time. All things considered, the most satisfactory method has been that in which the chicks are removed directly from the incubator to colony houses upon range well removed from the poultry plant, thus breaking disease contact as much as possible between the young and mature stock. Battery brooding has been shown to be satisfactory for short periods only, and particularly for starting early-hatched chicks before being taken to range, or for holding chicks after hatching until they can be shipped or otherwise disposed of.

Egg Production

Various methods of handling birds for egg production have been contrasted. One of the most radical, that of carrying laying pullets through the year confined to their houses, has been tried. It has been found that, provided the feeds used are so constituted as to make up for the lack of sunlight and of fresh green feeds, which birds in confinement usually lack, equally satisfactory egg production can be obtained. An outgrowth of the same principle, the laying battery, has also been introduced. Under this system each pullet is confined to its own compact wire cage, the cages being arranged in large batteries. Although confined to the extent of having only sufficient room to turn around readily, pullets under these conditions have been found to give at least as satisfactory production as those left in the laying house with large floor space on which to range. In this method, also, the adjustment of the feed to suit the condition has been the important factor in obtaining successful results.

Research with Feeds

A large amount of research has been devoted to the factors affecting the nutrition of poultry. Commercial ready-mixed mashes and mashes made up mostly of home-grown grains plus the necessary animal protein, mineral and vitamin supplements have been contrasted in the case of chicks and laying pullets, and found to be satisfactory for good growth or egg production. Cod liver oil, pilchard oil and cod liver oil concentrates have been shown to be satisfactory sources of vitamins for growth and egg production. For chicks or mature stock in confinement, particularly during the winter months, these vitamin supplements were found to be necessary for normal growth, egg production and hatchability. Numerous mashes of different analyses and with various proportions and types of ingredients have been tried out. Mashes most satisfactory for the purpose or purposes intended have been compounded and recommended for use. During most recent years experiments have been made comparing methods of fattening poultry for market as well as the most satisfactory feeds from the standpoint of gain in body weight and improvement in market quality.

Breeding for High Production

Extensive work in breeding for high production of large uniform eggs has been carried on by the use of trap nests, and by the selection of high-producing

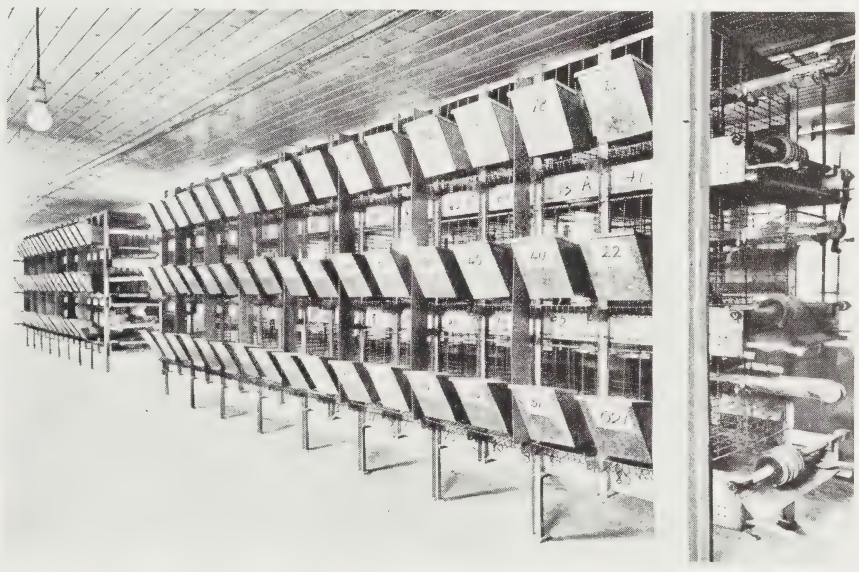
females mated to the sons of high producers whose sisters were high producers of large eggs. This selection was followed by progeny testing, discarding the poorer lines and propagating those lines that gave best results.

By these methods, high-producing lines of large-egg birds in Barred Plymouth Rocks, White Leghorns, White Wyandottes and Rhode Island Reds have been built up and stock has been distributed throughout the country.

Fundamental research into the physiology of reproduction is being conducted. This is designed to determine the factors influencing fertility and hatchability. It has been indicated that nutrition is of vital importance in the control of fertility and hatchability of eggs.

Opinions on the proper housing of poultry vary greatly. Investigations have been carried on with various types from the old closely built house without proper ventilation, the cotton-front, open-front and straw-loft types to the well constructed house with artificial heat and automatic ventilation. The latter undoubtedly is the one most nearly ideal, but expense must always be considered, and individual location and conditions must be a deciding factor.

Utility and economy both considered, the cotton-front house, that is one with the front having part cotton, part glass and part wood—the proportions depending on climatic conditions—has given most satisfactory results.



Battery laying house at Ottawa. Each bird is confined in a wire enclosure and has access only to its own feed and water supply.

Egg Laying Contests

In order to stimulate interest in the breeding of birds for increased egg production, an egg-laying contest was begun at the experimental station, Charlottetown, P.E.I., in the autumn of 1918. This contest proved very popular. In the following year the number of contests was increased to seven and in a very few years thirteen contests were being operated on the various experimental stations across Canada, there being at least one contest in each province. A pen consisted of ten birds and three spares, entered by poultry breeders. In addition to the provincial laying contests an international contest was conducted at the Central Farm at Ottawa. The increase in contest production from 122 eggs per bird in 1919-20 to 180 eggs per bird in 1934-35 is evidence of the value of a breeding program such as was established by these contests.

Through the medium of egg-laying contests a system of official registration has been established, the basis of which is standard qualifications combined with production and size of egg, with officially recorded ancestry. Canada is the first country to standardize egg-laying contests and to use the records as the basis for official registration. About 21,000 registration certificates have been issued.

A waterfowl plant is maintained where the leading varieties of domestic ducks and geese are kept. Growth costs are obtained and data secured indicating the suitability of the various breeds for various purposes. In wild fowl extensive trials have been made with Mallard ducks, and in geese the Canada and the Snow have been successfully bred.

Marketing Problems

Of recent years certain of the marketing problems have been the subject of research. The effect of storage and shipment upon egg quality and the possibility of an hereditary basis for keeping quality in eggs have been investigated. Preliminary work seems to indicate the individual bird to be the most important factor in egg quality as considered from the genetic aspect. A study of dressing percentages and of type in relation to meat quality and to official grades is under way.

Educational exhibits based upon the results of research work at Ottawa or the branch farms, are sent to all the more important fairs and shows in Canada. Another form of extension work is carried out through a "Farm, Egg and Poultry Account" system, whereby poultrymen may submit their business and methods for the advice of officers of the division for improvement in their poultry enterprise. Press articles are also regularly released.

Studies of Disease in Poultry

Investigational work into control of disease conditions is one of the most important phases of research work. Up to the present, methods of sanitation in the prevention of disease and its spread have mostly been dealt with. The use of wire floors in brooders and runs, the placing of eating and drinking vessels upon wire-covered frames to prevent reinfestation through consumption of contaminated feed material, and the rotation of yards and range paddocks have materially improved the viability and health of young stock. Pullorum disease has been entirely controlled upon the Experimental Farms System through the laboratory facilities at Ottawa and other points. A routine autopsy service for the branch farms and for the public has been given by poultry pathologists of the Health of Animals Branch.

TOBACCO

According to the census report of 1891, the total production of tobacco in Canada was 4,277,936 pounds. At this early date 90 per cent of the entire crop was grown in Quebec, usually on small fields for home consumption. Of the marketable product, due to the somewhat inefficient methods of handling, only about one-fifth was of sufficiently high quality for commercial manufacture. At the close of the last century Ontario, with its smaller acreage, was labouring under similar difficulties. It was obvious that the industry had possibilities—in 1897, 1,000 acres of tobacco were grown in Essex county, and 40 car loads of tobacco were shipped from the Leamington section—but many of the common practices in growing the crop were unsatisfactory.

Tobacco has been grown at the Central Experimental Farm since 1898, and the need for a special Dominion Tobacco Service was brought to the attention of the Minister of Agriculture in 1905. After much inquiry, the services of a French officer were obtained. He arrived in Canada in October, 1905, carried

out a general survey, and then started work as a tobacco expert, publishing in the following year two bulletins, one on hotbeds and the other on fertilizers. From the outset, the importance of improved quality was emphasized.

The evident need for definite information on fertilizers and suitable varieties was responded to by the establishment, in 1909, of experimental plots at St. Jacques l'Achigan, and St. Césaire, in Quebec, and at Harrow in Ontario. Organized as a Tobacco Branch, with offices in the city of Ottawa, it shortly afterwards became a division under the Experimental Farms Branch, with offices, warehouse and plots at the Central Experimental Farm. Permanent experimental stations were subsequently established at Harrow, Farnham, and L'Assomption, and later, in 1933, a tobacco sub-station at Delhi, Ont.

The tobacco sub-station at Delhi, Ont. From left to right, the layout of buildings shows the A-shaped tobacco beds, curing kilns, water supply, machine shed and pack barn.

Breeding and Selection for Desirable Types of Tobacco

Ever since the division was first organized improvement of type and quality by breeding and selection has constituted one of the major projects. In 1908 two technical assistants were added to the staff and definite plans were made to select type plants exhibiting desirable characteristics. Samples of seed for experimental purposes were imported from the United States, Cuba, Brazil, Sumatra, the Philippines and France. A few years later it was evidently realized that the process of mass selection was becoming tedious and irksome. A number of plants exhibiting varying characteristics were re-selected as parental stocks, and several crosses were attempted.

In 1914 the services of a plant breeder from the United States were acquired. He came to Canada equipped with a fund of information on burley and dark tobaccos, and contributed much to the industry before returning to the United States. For the next few years plant breeding was more or less neglected. This project was undertaken some years later with renewed vigour, and efforts are now being directed towards the improvement of quality, flavour and aroma, earliness of maturity and resistance to disease. Plants from varieties exhibiting one or more of these desirable characteristics have been selected as parental stocks and definite programs with specific objectives have been outlined.

Closely associated with the work of breeding is the constant testing of varieties which have proved to be popular in other countries. All undesirable

types are eliminated and studies are continued only on those of promise. Every varietal and hybrid selection is recorded and data are being accumulated on various plant characters as well as on relative maturity and resistance to disease. Although experimental work of this kind is necessarily slow, it is felt that a sound basis is being established for varietal improvement of all types.

During the 20-year farm test period, from 1908 to 1928, field tests with various fertilizers were conducted on selected farms and at tobacco sub-stations. The first work recorded was that started in 1908 on a farm near St. Césaire, Que. The conclusion was reached, that "even with a large application of barnyard manure it is impossible to maintain a rich fertility of tobacco soil without the addition of commercial fertilizers".

Experiments to test the most satisfactory combinations of manures and fertilizers for burley and cigar tobaccos date from the establishment of the experimental plots at St. Césaire, St. Jacques, and Harrow. Somewhat later, fertilizers for bright flue-cured types were tested.

In 1912 the St. Césaire demonstration station was replaced by one at Farnham. About this time the fertilizer work at Harrow was expanded. Of the several farm tests conducted, the most extensive was one at Walkerville, Ont., to study fertilizers in relation to black root-rot.

The importance of these earlier efforts cannot be over-emphasized. Increases in yields were enormous; the quality was improved; financial returns were phenomenal. From the careless methods of the decade preceding 1918 were developed common-sense practices based on experimental evidence.

The ultimate objective in the fertilizer work since 1928 has been to determine the fundamental laws concerned with the nutrition of the tobacco plant, as well as facts of direct practical importance to the grower. Probably the greatest recent contribution has been the formulation of fertilizer recommendations, based on experimental results obtained in Canada, for different types of tobacco produced. Brands of fertilizer mixed especially for tobacco, may now be purchased, and the grower can feel secure in the knowledge that such brands meet the standards formulated by the Tobacco Fertilizer Committee.

As far back as 1906 soil studies were largely incidental to other major projects dealing with varieties, manures and rotations. In 1916, when a physical and chemical survey of flue-cured burley and cigar tobacco soils was begun, definite recommendations to prospective growers were made possible.

A New Tobacco Belt Opens Up

In 1919, in response to many enquiries, an additional survey was made in Norfolk county. The subsequent opening up of the "New Belt" in Ontario is now history, and it is pertinent to remember that this was due entirely to the efforts of the Dominion Tobacco Service in investigating the possibilities of this region through the physical and chemical analysis of the soil. Once it was established that soil and weather conditions were suited to the production of tobacco, eventual expansion into the Norfolk area was only a question of time.

More recently, work has been started on a number of soil problems. In 1933, at the Central Experimental Farm, efforts were made to establish the correlation between soil type and the general quality and yield of cigar tobacco. Conclusions drawn were that fine sand produced leaf of better colour, texture and burning quality than did other soil types, but the yield was not so large as when tobacco was grown on sandy-loam soils. Clay loams showed good yields but leaf of indifferent quality. Under the supervision of the Harrow station, trials designed to correlate soil type, fertilizer and type of tobacco have been run for a number of years in various parts of southwestern Ontario. In 1933 an analysis of the soil types in the vicinity of Farnham, Que., including the well-known river soils, was begun by the Farnham staff. That year also, soil-

type studies with flue-cured tobacco were begun in Norfolk county. Investigations in British Columbia have shown that the light-coloured loams of the Okanagan valley and the sandy soils of the Sumas are fairly well adapted to the production of flue-cured and burley tobacco.

It is likely that in the future more and more stress will be laid on the question of tobacco lands, because nothing else is so basic to any agricultural enterprise as the soil.

Tobacco Market Developments

Prior to the granting of an Imperial Preference in 1918, attention was concentrated chiefly on the Canadian market. Early in 1917, however, the British Government as a war measure restricted the importation of tobaccos from neutral countries to one-third of the amount imported in 1915. An immediate demand for Empire tobaccos was created. In 1918 an Imperial preference of one-sixth was granted, and immediate steps were taken to develop an export trade, mainly by bringing together Canadian leaf dealers and United Kingdom importers. In 1920 the chief of the division spent some time in the Old Country and France, interviewing the trade. He took with him a full line of burley and bright flue-cured tobaccos, as well as cigar leaf. His report indicated that except for flue-cured tobacco, the possibility of developing a large export market was remote. Nevertheless, after the collapse of the market in the winter of 1921 and the consequent limited production for a few years, exports rose steadily from 200,000 pounds in 1921 to 2,000,000 pounds in 1924.

Large and representative collections of Canadian leaf samples were exhibited in London in 1924, 1925 and 1929. In 1929 the truth of an earlier report regarding the limited nature of the English market for burley became more fully appreciated, as did also the fact that Canadian darks would encounter severe competition from other Empire countries. It was then noted that if any large share of the English trade was to be secured an effort must be made to introduce the bright flue-cured type for cigarette manufacture. A further survey of the Old Country market was made in 1933, when the representative of the Dominion service worked in conjunction with a representative of the flue-cured tobacco growers of Ontario.

In general, the division had endeavoured to serve as a clearing house on market information, to bring together buyer and seller, to furnish statistical data, to investigate market conditions, and to advise the growers on the qualities and quantities required. Close co-operation has been maintained with the Commercial Intelligence Service and the Dominion Bureau of Statistics in the Department of Trade and Commerce. Through this co-operation specialized statistical information has been made available to growers and the tobacco trade.

An Established Industry

Since 1906 commercial tobacco production has expanded from about 10,000,000 pounds to approximately 55,000,000 pounds in 1935. Of recent years the tobacco industry of Canada has contributed annually to the national revenue between $30,000,000 and $40,000,000 in duties and excise. Through co-ordinated tobacco research on the Dominion branch farms and the application of the most recent experimental findings, Canadian tobacco production has advanced to a high degree of specialization. The high quality of Canadian-grown leaf is now recognized by both English and Canadian manufacturers. As a result of improved quality the importation of foreign tobacco has rapidly declined during the past decade. In 1934 about 75 per cent of the tobacco used in Canadian manufacture was produced in Canada. The industry is thus becoming more and more firmly established on a quality production basis.

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The Branch Units

THE 30 branch farms and stations are flung across the settled part of Canada from ocean to ocean, with sub-stations reaching almost to the Arctic Circle. Most of the principal units serve their constituencies broadly, although some specialize to a greater or lesser extent and a few concentrate upon specific objectives. Within the compass of this publication it is quite inpracticable to indicate all the important projects that have received attention at each unit. Even if space permitted the recital, the similarity of many of the accounts would become tiresome to the general reader, however acceptable each story might be within a particular zone.

The course chosen has been to present a few of the most notable findings of each branch farm and station with particular attention to data of the widest application and the greatest popular interest. Scant justice is unavoidably done to the older and more aggressive farms and stations, all of which have writ their names large in the agricultural development of the Dominion. Details are available in pamphlets, bulletins and periodical reports.

EXPERIMENTAL STATION, CHARLOTTETOWN, P.E.I.

The experimental station serving Prince Edward Island was established in the Royalty of Charlottetown in 1909 on an area of 29 acres purchased by the Prince Edward Island Government and leased on a long-term basis to the Dominion Department of Agriculture.

The residence was originally built, about the beginning of the last century, for the land agent of one of the large areas, or lots, granted by the British Crown. It is situated about a mile northeast of Charlottetown, on rising land, overlooking the Hillsborough river in grounds profuse with the bloom of trees, shrubs and flowering plants which the cool, maritime climate develops to perfection. The original area has been augmented to 173 acres by subsequent purchase along both sides of the railway, so that the station buildings, the farm rotations and many of the experimental plots can be seen by travellers.

The soil of a dull red colour is formed from the Triassic red sandstone that underlies the province. In general it is a sandy loam underlaid with a hardpan of gravelly brick clay, but the soil ranges from almost pure sand to heavy clay, with an area of peat that has been reclaimed by drainage.

The station is the Island farmers' headquarters for agricultural information; the results of years of study of soils, crops, fertilizer and farm management are available to all. Moreover, the station widens its sphere of usefulness by assisting in extension work throughout the province, and maintains the only first-class meteorological station on the Island.

A Barley Variety of Outstanding Merit

With cereals the outstanding single achievement to date is, perhaps, the development of Charlottetown No. 80 barley, a two-rowed variety with a marked tendency to drop its awns. The initial selection was made in 1912, and the variety was first registered in 1916. More recently, with improved equipment and with trained assistance, considerable work has been done in breeding a number of cereal varieties better suited to Prince Edward Island. The aim is to produce a superior wheat and hulless and smooth-awned varieties of barley to meet the local requirements.

Pasture improvement, including a study of grasses and clovers alone and in combination, has been an important part of a greatly extended program of

work with forage crops. Fertilization has greatly increased the carrying capacity of pastures, and proper management has preserved the nutritive value of pasture grasses throughout the grazing season.

The maritime climate, with its moderate summer temperatures, favours particularly the growing of roots. Swede turnips and mangels yield heavily and table turnips are shipped in large quantities to Canadian and United States markets. Diseases of roots have received attention. Seed of varieties of swedes found to be most resistant to disease has been propagated, and 10 to 15 pounds of borax per acre has been recommended as a control for brown-heart of turnips.

A demonstration of jointer ploughs at the station field day. Mr. James McLean, noted ploughman is speaking.

Four of the original six farm rotations laid out in 1912 are still being continued and the records kept of their production of the various farm crops have been very useful for demonstrating cropping systems, control of weeds, etc., to farmers and others who visit the station. In addition, experimental work on 300 small plots has contributed greatly to the knowledge of cultural practices. These plots have shown, among other things, that early-autumn ploughing of sod will produce much better crops of grain than will spring ploughing; ploughing in August and top-working the soil in the autumn destroyed weeds and gave a significant increase in yields of grain; and that land after hoed-crops, roots or potatoes, gave better crops of grain and hay if it was worked into a seed bed without being ploughed.

Value of Farm Gardens Stressed

The station has continually urged land owners to pay more attention to the farm garden; and now that it has been demonstrated that many fruits, vegetables, and flowers hitherto considered tender for Prince Edward Island may be safely grown by proper cultural methods and by choosing early varieties, many of the better sorts have been propagated and sold or distributed to the schools, women's institutes and farmers of the province.

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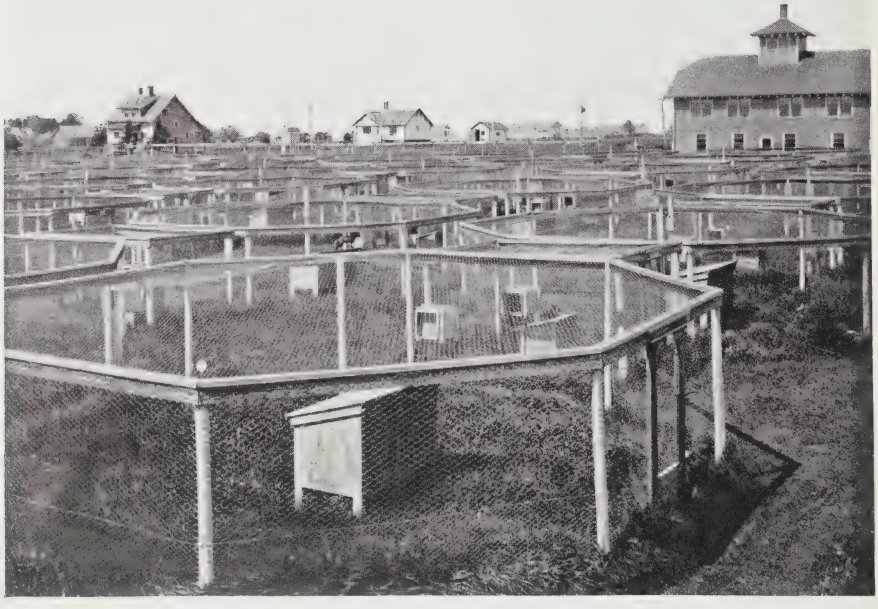
Every animal in the accredited herd of Ayrshires has been entered in Record of Performance, and annual tests have shown the herd to be free from Bang's disease. Clydesdale horses are used for farm work.

By careful progeny breeding and by other methods, the Barred Plymouth Rock flock at the station has been brought to a very high average of egg production, with low mortality, and with the body type required for the best world markets. It was at the Charlottetown station in the autumn of 1918 that the federal system of egg laying contests was begun.

EXPERIMENTAL FOX RANCH, SUMMERSIDE, P.E.I.

Silver-fox ranching represents one of the first attempts to raise wild animals commercially in captivity and it is not surprising that the early breeders had to confess after several years of trial that they knew almost nothing about sound ranching methods. For the success of the industry it was essential that reliable information on the nutritional requirements of foxes should be obtained, that sound methods of controlling external and internal parasites should be evolved, and that a thorough understanding of the various fur-inheritance factors should be obtained. The breeders therefore urged the Dominion Government to investigate their problems scientifically and offered to share the cost of constructing a research institution for that purpose. As a result, the experimental fox ranch was established at Summerside, Prince Edward Island, in 1925, the land being donated by Island business men, the ranch being constructed at the expense of the Canadian National Silver Fox Breeders' Association, and 25 pairs of registered silver foxes being donated by the fox breeders of the province.



Part of the equipment at the experimental fox ranch.

Difficulties in the Early Days

In the early days of ranching the wide spread between the selling price of foxes and pelts and the cost of food tempted breeders to be lax and extravagant in their feeding methods, particularly with regard to meat. Through excessive overfeeding, "samsons" and other off-furred foxes were produced in large numbers. Experimental work at the ranch determined the total caloric requirements for a fox, and by studying the live weight and the development of the fur with rations at different protein levels, the protein requirements were determined within very narrow limits, so that definite recommendations could be made regarding the amount of meat that should be fed to foxes during different seasons of the year. Pups, too, were often irretrievably ruined before they were three months of age by improper feeding, but experiments demonstrated the definite relationship between the caloric value of the food and the natural increase in weight of growing pups and enabled the ranch to recommend the amounts that should be fed to pups at different stages of growth. Moreover, other experiments have shown that foxes should be fed in step with the season; green vegetation in the summer, ripe vegetation in the fall, and young shoots and buds of vegetation or their equivalent in the spring. The proper diets evolved at Summerside have enabled breeders to raise foxes profitably even during the recent depression period.

Reproduction also presented a sequence of disasters to ranchers. In addition to the fact that mating was difficult and often unsuccessful, an excessive number of the pups that were produced were lost at birth. The yield for each pair was less than one pup per annum on the ranches throughout the Dominion. Very important facts were established with regard to the normal annual life cycle of breeding foxes. It was clearly demonstrated that there was a natural minimum weight to which foxes should be reduced during the summer months, and for successful breeding results there should be an increase of 50 per cent in weight during the fall months. Breeders now strive to have their animals as fat as possible during the breeding season. The annual average production during recent years has been well over three pups per pair in the great majority of ranches throughout the Dominion. Testing of males has also helped to bring about a marked decrease in the number of barren matings.

Fox breeders have been alarmed each year at the large number of their pups that had lost the white tip, for a favourable white tip at the end of the tail had always been considered an important asset in the sale of live foxes. The fox ranch demonstrated that spontaneous fracture of the tail was due to infantile scurvy and that the complaint can be warded off by supplementing the rations the year round with food substances rich in vitamin C. In previous years bobtailed foxes were prevalent, but in recent years they are rarely seen.

Parasites Present Many Problems

External parasites have been a menace to foxes from the early stages of fox ranching. The common practice was to apply flea powders and other remedies which, however, left the foxes open to reinfestation. Control was attempted by attacking the parasites during that part of their life cycle when they were not infesting the foxes, the nests, kennels, and all the woodwork of the pens being sprayed with ordinary fuel oil. During the last three years no fleas, earmites, or other external parasites have been observed on the foxes at the ranch, and breeders who have followed those recommendations report that by spraying with fuel oil they have saved large expenditure and yet rid their ranches of fleas.

Hookworms, round worms, lungworms and bladderworms became very general with the great majority of foxes in captivity. The lungworm and the bladderworm infestation reached a stage almost threatening the ruin of fox ranching in certain localities. It has been demonstrated that keeping foxes on

board floors during the summer months was a complete control of both lungworm and bladderworm infestation, and this practice has become general throughout the industry.

Due to improper methods of feeding, breeding and general care, there was an alarming production of low-grade pelts, the fur being off colour with poor development both of fur and hide. Even foxes with desirable inherent qualities acquired a pronounced brown shade or other unfavourable appearances, while a much larger number with inferior genetic constitution were used as breeding stock to the detriment of the industry. Genetic studies revealed many inherent qualities that tend to produce desirable fur characters such as dense pigmentation, desirable length, lustre, density and brightness of silver. These studies indicated the basic factors which cause pelts to be lacking in these qualities. The ranch has obtained a great deal of information regarding the nutritional, inherent and other factors influencing the development of the colour, lustre, strength, length, and the other desirable qualities of silver fox fur, so that rational selection of breeding stock is now possible.

Work is being continued on the many problems in feeding, breeding and environment which still confront the fox rancher.

EXPERIMENTAL FARM, NAPPAN, N.S.

On the Intercolonial main line, now part of the Canadian National Railways, at a point about eight miles from the New Brunswick boundary, is the experimental farm at Nappan, N.S. The farm was originally intended to serve the three Maritime Provinces, but since the establishment of three other stations at Kentville, N.S., Fredericton, N.B., and Charlottetown, P.E.I., it has been styled "The Experimental Farm for Eastern Nova Scotia". At first its scope was general, but it is now becoming increasingly specialized on field crops, soil culture and animal husbandry.

An aerial view of the fields and buildings at the experimental farm, Nappan, N.S.

The farm is beautifully situated on rising land overlooking Cumberland Basin, the Shepody mountain and a wide sweep of the dyke-land for which the region is famous. The grounds, while not extensive, are attractively laid out, the lawns being graced with many beautiful, and some rare, ornamental trees and shrubs. Their planting was personally supervised by Dr. William Saunders and Col. William Blair, the first superintendent of the farm.

To the original property of 290 acres of upland and 45 acres of dyke-land an adjoining farm was added in 1919, bringing the area up to 492 acres, of which 303 acres of upland and 77 acres of dyke-land are under cultivation. The remainder is in woods and rough pasture.

The soil affords a wide range for cultural studies. It is chiefly medium to heavy clay loam, with some areas of sandy loam and others of a gravelly nature. In addition, there is the dyke-land soil, a fine, sticky, clay loam, with an occasional sandy deposit, built up from heavy deposits of silt from the tides of the Bay of Fundy.

Farming the Dyke-lands

The dyke-land of this farm forms a part of one of the largest tracts of dyke-land on the continent. Its forty to fifty thousand acres comprises several extensive bodies, the largest of which are known as the Tantramar, Missaquash, LaPlanche and McGowan. In the centre of the dyke-lands stands old Fort Beauséjour, the last stronghold of the French in Acadia. These vast dyke-lands will ever remain a tribute to the work of the French, for it was they who first won them from the tides of Fundy.

When first reclaimed, the soil was very rich in plant food and yielded an abundance of excellent hay, and the land continued to produce good hay crops while the practice of opening the flood gates periodically was followed. But flooding has been almost wholly discontinued, and as, with few exceptions, no other method of fertilization has been adopted, the crops have gradually become smaller and poorer in quality. Hay has been grown on some of these areas for more than 150 years without cultivation or fertilization.

Naturally, dyke-land improvement is one of the major fields of study at Nappan. The cultural tests, which include three-, four- and eight-year rotations, proper drainage and the different rates and methods of applying fertilizer, barnyard manure, ground limestone, basic slag, and wood ashes, have shown conclusively that the dyke-lands respond not only quickly but profitably to good drainage, cultivation and fertilization, and that they will yield excellent crops not only of hay but of other crops as well, as acre yields of 73 bushels of oats, 25 bushels of barley, 18 tons of swedes and 16 tons of sunflowers convincingly testify.

But the investigation of the dyke-lands has not been the only activity at Nappan. The farm has collected figures to show that under proper methods of cultivation and fertilization all the principal feed crops can be produced as cheaply in Nova Scotia as they can be purchased in the open market.

Demonstrating the Value of Good Seed

Special attention is also given to the comparative testing of cereals and forage crops. A most valuable test of samples of oats taken from farmers' seed drills showed that the yield ranged from 48 to 72 bushels per acre, that one sample ran 48 per cent smut, actual count, that most samples were mixtures, and that 8 out of 30 samples were 90 per cent true to the name given.

Of all the work done with forage crops, none has proved of greater value to the farmer than the selecting, growing and testing of club-root-resistant swedes. Although perfect freedom has not been obtained, the degree of resistance found in the two varieties, Wilhelmsburger and Bangholm Herning, means a saving of many thousands of dollars throughout the Maritime Provinces.

The dairy herd is composed of the two chief Channel Island breeds—Guernseys and Jerseys. The Guernsey cow King's Blanche of Hillside, a daughter of Filmore's King of Berwick and out of Buttercup's Blanche, had a mature record of 12,230 pounds of milk, yielding 752 pounds of fat. The breeding project that should prove of greatest interest to the average breeder was the grading up of a dairy herd by the use of pure-bred sires of proved ancestry—a project that clearly demonstrated the importance of the herd sire.

Evaluating Fish Meal as a Live Stock Feed

Nappan has been the field for some of the most extensive work done in Canada in testing the value of white-fish meal as a source of animal protein for all classes of live stock—particularly for the growing and finishing of bacon hogs. The average results obtained with a large number of hogs show that white-fish meal, low in oil, is one of the most economical and adequate sources of animal protein, and that it is equalled only by skim-milk for the growing and finishing of bacon hogs. The average daily gain from 14 trials was 1·24 pounds for those receiving skim-milk and 1·20 pounds for those receiving fish meal. The unit cost was 6·05 and 6·26 cents respectively. It was necessary, however, to feed minerals to hogs receiving skim-milk, but not to those receiving fish meal. Very satisfactory daily gains ranging to 1·5 pounds are now being obtained from feeding just fish meal and potatoes in finishing bacon hogs.

The poultry work is also of major importance. Data are being compiled on pedigree breeding, and on feeds and feeding. The average production of the farm flock has been raised from a 1926-27 figure of 146 eggs to a 1934-35 figure of 177. The returns over feed cost from the farm flock have ranged from $1.25 to $2.00 per bird per annum.

EXPERIMENTAL STATION, KENTVILLE, N.S.

The experimental station at Kentville, Nova Scotia, grew out of a request by fruit growers in Kings, Annapolis and Hants counties for assistance so that experimental work might be carried on to help them in their business. To meet this request the Nova Scotia Fruit Growers' Association centred its early educational efforts in the establishment of a horticultural school at Wolfville, and when this school was incorporated with the Nova Scotia Agricultural College at Truro, an understanding was arrived at with the provincial Department of Agriculture for the provision of a fruit station to take its place.

For this purpose the province bought property in 1910 at Kentville, in the famed Annapolis valley, and 1911 the Dominion Department of Agriculture took it over as a unit in the Experimental Farms System.

J. R. Starr began operations during 1911, and under his direction sufficient land was cleared to permit 12 acres of orchard to be planted in 1912. In July of that year the present superintendent, W. S. Blair, assumed his duties.

Acquisitions have extended the original area from 250 to 453 acres, situated, for the most part, within the boundary of the town of Kentville. The surface soil is mostly a sandy loam; the sub-soil ranges from sandy to clay loam, more or less gravelly. About 20 acres have so far been underdrained, a practice necessary for satisfactory experimentation wherever the clay subsoil predominates. Since the establishment of the station, 150 acres have been cleared and broken, mostly from green forest.

Naturally the station is concerned mainly with horticulture, with the problems encountered in selecting varieties, in growing them, and in handling and marketing the products. The original planting of 65 acres included 240 varieties of apples, 55 of pears, 92 of plums, 54 of cherries, 47 of peaches and 12 of quinces and apricots. Many of the pears and apples have been grafted out as unsuitable, and although some peaches are still being grown, the original

plantings of peach and apricot trees have gradually dropped out. These variety tests have determined the sorts best suited for the Annapolis valley, and have prevented the indiscriminate planting of undesirables.

From the tests and comparisons of fertilizer treatments, cultural methods and spray programs which have been conducted continuously since the first plantings were made, orchard practices consistently profitable to growers have been developed.

Variety Study Helps to Solve Pollination Problem

Moreover, the practical results from several years of pollination work with standard varieties to determine the value of insects in securing a good set of fruit and to ascertain which varieties were effective pollinators and which were not, may now be seen in the present practice of setting out suitable varieties together, rather than in large, separate blocks which inhibit effective pollination. This pollination work has also made possible the extensive crossing of varieties: 15 acres are now planted to 30,000 seedlings from these crosses for evaluation.

Gravenstein and Wagener apple trees planted alternately in the row in 1913 and spaced 40 by 20 feet. The tents at the far end of the row are used for pollination studies.

Considerable attention has been given to the processing of fruit juices and to the canning and dehydration of fruits. An effort has been made to improve the apples used for canning and drying by better handling of the fruit, and to secure a more economical production and a higher quality pack by the elimination of the small sizes. Improvements have been made in the type of dehydrator and in its management, so that the product is more uniform and better cured.

Further experimental work in handling the crop was made possible when cold-storage equipment was installed in the apple warehouse in 1932. Different storage temperatures have been tested and the behaviour of fruit from plots differently fertilized has been studied. The shipment to England of some 8,000

barrels of apples under different methods of handling, packing and transportation, besides having been of great benefit to growers, has shown how handling the crop can be improved.

But apples and other tree fruits are not the only horticultural crops that have been studied at Kentville. Small fruits have been tested and two acres each year have been devoted to vegetable culture, the work with potatoes centering largely around the use of potato seed stock free from disease. The canning and processing of different vegetables have also received much attention.

The honey bee is recognized as a necessary part of good orcharding as it distributes pollen and helps to secure a commercial set of fruit. Since more spraying than dusting of orchards has been practised, far fewer bees have been lost from poisoning, and the development of satisfactory colonies for honey production has been possible. About 100 colonies are carried at the station for experimental work and production purposes.

The attempted improvement of permanent pastures by the use of complete fertilizer and lime has given promising results. Attention has been given to the development of club-root-resistant strains of swedes—particularly Bangholm—and to tests for the control of brown-heart.

Tests Reveal Value of Fertilizers

Commercial fertilizers are used more extensively in this district than in any other part of Canada. Tests have shown that a properly balanced fertilizer suitable for the crop is essential, and that all farm crops other than potatoes respond markedly to applications of lime with the fertilizers.

In poultry, the use for breeding purposes of the highest-producing pullets has resulted in a gradual increase in the number and size of eggs, and in the building up of a good strain of Barred Plymouth Rocks from which those so desiring may improve their flocks. The Nova Scotia Southern Egg Laying Contest is conducted at Kentville.

The only cattle kept at the station are dual-purpose Shorthorns. All the cows are carried in the Record of Performance test and an effort is made to retain the beef conformation as much as possible. The bull calves are readily disposed of as breeders and such females as can be spared are also sold. The demand for this type of stock is rapidly increasing.

EXPERIMENTAL STATION, FREDERICTON, N.B.

Situated on the banks of the Saint John river, close to the capital city of Fredericton, the experimental station for New Brunswick has the advantage of central position. When the station was established in 1912 the cultivated land was confined largely to a strip along the main highway; now, after developing rapidly, it comprises 630 acres, with approximately 425 acres devoted to lawns, gardens, orchards, plots, pastures and cultivated fields.

The station is well equipped with modern farm buildings. A dormitory capable of housing 60 students and a dining room providing accommodation for 150 people have recently been added to supplement the New Brunswick Agricultural School equipment and to provide facilities for special field days. Stimulation has thus been given to the policy of participation in the agricultural education of the province.

Situated in a province in which general farming predominates, but at the same time serving specialized sections, the station covers in its work all the main branches of agriculture: its findings are put into practice on 20 illustration stations so located in the provinces as to bring the station into intimate contact with as many farmers as possible.

Outstanding Dairy Cattle

For many years fully-accredited herds of pure-bred Holstein and Ayrshire cattle were maintained. Among the outstanding R.O.P. records established is that of the Ayrshire cow, Fredericton Spottie 3rd–114055. She won the silver cup donated by the Canadian Ayrshire Breeders' Association by establishing a Canadian Ayrshire record for butterfat production for a three-year-old—15,491 pounds milk and 765 pounds of butterfat. She was runner-up for the cup as a five-year-old. In 1935, eight females belonging to the Spottie family were in the herd. In 1936, however, in accordance with the general policy that each station should concentrate on one breed only, the Ayrshire herd was disbanded, the best of the animals being sent to other stations. The Holstein herd has been developed so that it now ranks among the outstanding herds in the Maritime Provinces.

A grazing scene at the Fredericton station showing a pasture where the grass has been kept under proper control throughout the grazing season.

The Yorkshire herd, in which all the mature sows have qualified for Advanced Registry, has been the source of breeding stock for many of the leading private breeders. Feeding experiments have demonstrated that potatoes are valuable for hogs when fed with farm grains and balanced with either skim-milk or fish meal.

Two active organizations, the New Brunswick Registered Poultry Breeders' Association and the Poultry Producers of New Brunswick, have come into being as the result of poultry field days held at the station. Only Barred Plymouth Rocks are kept, and the breeding stock is all registered: the many outstanding records made by the New Brunswick Egg Laying Contest have done much to gain wide recognition for this breed. Control of pullorum disease by sanitation and the disposal of reactors to the blood test was begun in 1924, when chick mortality was extremely high. The first test showed 34·4 per cent of the flock to be infected. There have been no positive reactors for the past five years, and chick mortality is now negligible.

Fertilizer Studies Yield Valuable Information

Fertilizer studies have been extended to cover the study in detail of the nutrition of certain crops, including the relation of certain rarer elements to the occurrence of various deficiency diseases under field conditions. Experiments carried on under the direction of a committee representing all the experimental farms and stations, pathological laboratories and illustration stations in the Maritime Provinces have proved that borax applied at the rate of 15 pounds in the drill and 30 pounds broadcast per acre will control brown-heart of turnips, a deficiency disorder very general throughout the province. A deficiency of boron has also been found to be responsible for the occurrence of corky core in apples, a disorder which causes widespread damage in certain orchards.

A nutritional experiment in sand cultures is being conducted with the potato. Excess and deficiency symptoms have been determined for a number of elements, and the necessity of maintaining the proper balance between the various elements has been emphasized. The possibility of growing potatoes uninterruptedly on the same area is under investigation; five-year results indicate the value of a rotation and the desirability of applying a combination of commercial fertilizers and barnyard manure if potatoes are grown continuously.

Breeding for Superior Types of Potatoes

A comprehensive potato-breeding program is being carried on in co-operation with the laboratory of plant pathology at the station. About 26,000 seedlings have been produced to date, of which approximately 8,000 have been reserved for further trial. Breeding material has been collected from various countries in Europe, from South America and from the United States. Wild species of Solanum are being utilized in late-blight studies.

Pasture improvement investigations, begun in a small way in 1922 and now including ten projects, have provided the information which has been responsible for the system of improved pasture management now used throughout the province.

Investigations in the commercial, variety and seedling orchards have been designed to serve the needs of the young but rapidly growing apple industry. In tests of more than 200 varieties of apples, Sandow, a seedling produced by the Central Experimental Farm, was spotted as a promising winter variety. It is now being widely tested in New Brunswick and is attracting considerable attention in other provinces.

Apple breeding is carried on. Of approximately 5,200 apple seedlings produced, 600 have so far fruited. A variety orchard containing many new winter apples was established recently. Provision has been made for determining, from the standpoint of hardiness, the value of top-working winter varieties on a hardy framework.

Storage investigations have demonstrated that Fameuse and McIntosh apples are frequently picked when immature. These varieties should be picked as late as is consistent with commercial practice.

EXPERIMENTAL STATION, STE. ANNE DE LA POCATIÈRE, QUE.

Since its establishment in 1910 the experimental station at Ste. Anne de la Pocatière has been specially charged with the responsibility of establishing facts on urgent farm problems for the immediate districts of the St. Lawrence valley and Gaspe peninsula in the province of Quebec. The experimental program has included work in a great number of fields to correspond with the diversified farming enterprises prevailing in these districts, and co-operation has also been maintained with other institutions in experimenting on still wider problems. The station has been mainly concerned with methods of obtaining high yields

with feed and cash crops, the breeding and management of live stock for a high production of milk, meat, eggs or wool, and the raising of good breeding draught horses.

For nearly 20 years Percheron horses, Ayrshire cows, Yorkshire pigs, Leicester sheep and Barred Plymouth Rock poultry have been raised successfully and a great number of pedigreed animals have been distributed throughout the district.

A group of Percheron breeding mares raised at the experimental station, Ste. Anne de la Pocatière, Que.

Comparative figures on cost of production have been ascertained from time to time for various classes of live stock. Only a brief statement of the results can be given here.

The average total cost of raising a colt was $49.72, from birth to one year, and $106.20 from weaning to working age. The average feed cost per horse working hour was established at $0·058. The mean annual feed cost of keeping a breeding stallion was $83·93.

A Study of Dairy Farming Costs

One hundred and seventy-two cows have been registered in the Canadian Record of Performance and six have won silver cups for high official records. The average production cost of milk has been estimated to be $0.87 per hundred pounds and of butter, $0.172 per pound. The cost of raising a calf from birth to one year old was $32.86, and from birth to first calving $76.47. The cost of milk production with mixed corn and sunflower silage was $0.92 per hundred pounds, with roots, $0.84, and with oats-peas-and-vetch hay, $1.00.

Since 1930, 24 sows and 6 boars have been qualified in the Advanced Registry. The annual cost of keeping brood sows was $38.43, of a breeding boar, $37.65, and of raising pigs to weaning age, $3.53. The mean feed cost of gain was $5.37 per 100 pounds when unmarketable potatoes were fed to hogs at the rate of two pounds for one of meal, $4.90 when fed at the rate of four for one of meal, and $6.10 when potatoes were not fed. Turnips fed to market hogs reduced the cost of gain from $4.90 per hundredweight (without turnips) to

$3.90. With home-grown feeds the cost of pork production was $4.21 per 100 pounds and with commercial feeds $4.49.

Approximately 80 per cent of the male rams raised have been classified XXX every year under the Federal Ram Grading Policy. The annual cost of keeping an adult sheep was $6.15; the cost of raising a lamb to breeding age at 8 months, $4.29; and to 18 months, $7.95. Of the lambs born to yearling ewes 75·5 per cent were raised to maturity, 48 per cent were suitable for breeding and 50 per cent were twins; and of the lambs from ewes lambed at two years the corresponding figures were 84·9, 83·4 and 71·4 per cent.

Poultry Improvement Program Raises Production per Hen

The mean egg production of the Barred Plymouth Rocks improved from 124 eggs in 1923 for the best lot of 15 to 261 in 1934. The mean cost of feeding was $1.60 per hen, while the revenue was $4.02. The average records for all birds tested in the egg laying contest were: in 1922, 112·0 eggs with 5·5 per cent of qualified birds, and in 1934, 201·1 eggs with 42·6 per cent qualified birds. Other production, hatching, and cost figures, secured over a period of years, have enabled the station to make recommendations for the more profitable raising of poultry.

Since approximately 60 per cent of the cost of producing milk, eggs and meat lies in the feed, the cheap production of crops is an essential factor of success. For the last 12 years the mean cost of production of hoed crops was: for corn silage, $3.69 per ton; sunflower silage, $3.03; mixed sunflower silage, $3.16; swede turnips, $3.03; and mangels, $2.73 per ton. With hay crops, the costs were: for clover, $7.28 per ton; for mixed clover and alfalfa, $5.42; for timothy, $6.74, and for oats-peas-and-vetch hay $9.25. With the grain crops, such costs of production are: for oats, $0.47 per bushel; for wheat, $1.08; for barley, $0.90; and for peas, $1.06.

Since 1924 a test of different rotation systems has shown the advantage of a four-year rotation including hoed crops, grain and two years of hay or three crops of hay and part pasture. This rotation was also the most effective in weed eradication.

For potatoes the recommended fertilizer treatment is 1,600 pounds of a 3-8-8 fertilizer mixture; for turnips, 10 tons of barnyard manure plus 675 pounds of a 5-12-8 mixture. In renovating pasture on light soil, the recommendations are two tons of lime and 300 pounds of superphosphate.

Recommended Varieties of Field Crops

The production of registered and Elite stock seed has been extensively maintained with Banner oats, Mensury barley, Huron wheat, and Arthur peas. The testing of several pedigree strains of cereals reveals that for the district the best varieties of wheat are Huron, Marquis and Reward; of barley, Bearer, O.A.C. 21, and Himalayan; of oats, Banner, Victory and Alaska; of peas, Arthur, Early Raymond and Chancellor; of flax for seed, Novelty and Redwing; of beans, Genessee and Burbank.. Among the best mixed combinations of cereal crops are Chancellor peas with Alaska oats; Banner oats with O.A.C. 21 barley; Banner oats and Charlottetown 80 barley with Reward wheat; Chancellor peas and Alaska oats with Star barley; Chancellor peas and Alaska oats with Reward wheat.

Of all the varieties of the common forage crops, the most successful ones at Ste. Anne de la Pocatière are: mangels, Yellow Tankard, and Danish Sludstrup; swede turnips: Ditmars, Purple Top; annual green hay: oats and peas, oats, peas and vetch; Japanese millet; soybeans: Manitoba Brown, Wisconsin Black; alfalfa: Grimm, Ontario Variegated; red clover: Ottawa Selection, Yamaska; timothy: Svalof, Swallow and Cornell 1777. The preferred mixture of grasses

and legumes for hay is composed of eight pounds of timothy, five of alfalfa and five of red clover; and for pasture it is of eight pounds of timothy, four red clover, two alsike and four Kentucky blue grass.

EXPERIMENTAL STATION, CAP ROUGE, QUE.

The experimental station for Central Quebec is situated in Cap Rouge village, about nine miles west of the historic city of Quebec, on 350 acres of land which, varying from a light sandy to a heavy clayey loam, represents all classes of soil found in the district.

From its inception in 1911 until 1933 the Cap Rouge station concentrated on the breeding of French-Canadian (now Canadian) horses and cattle. Since 1933 the horse-breeding experiment, located at St. Joachim, has been under the supervision of the Ste. Anne de la Pocatière station. The building up of a good herd of Canadian cattle is still in progress at Cap Rouge, but prominence has been given since 1933 to horticultural and poultry problems.

Live Stock Breeding Methods Compared

Up until 1933 the station followed an inbreeding program with the cattle, and while the results may not be what had been anticipated, they are nevertheless interesting. Records show that the average production of the foundation

Canadian cattle bred at the experimental station, Cap Rouge, Que. This distinctive breed is especially suited to certain sections of the province of Quebec.

cows in 1915 was 5,463 pounds of milk testing 4·24 per cent fat, but that the 1933 herd average was 7,496 pounds of milk testing 4·67 per cent fat. Moreover, the average production of daughters of the foundation cows was only 4,230 pounds of milk testing 4·47 per cent in 1915, but the production of daughters of cows in the herd in 1933 was 8,636 pounds of milk testing 4·87 per cent fat. These increases were made by selecting the best producing stock and by using good sires.

Unfortunately, however, while production records were increased by this inbreeding and selection program, type suffered considerably. In an endeavour to improve type the breeding policy was changed somewhat in 1933. Bulls of outside blood have been introduced into the herd, and although production figures cannot be given because none of the outbred heifers are yet in milk, they are better-balanced, smoother-typed individuals than were their dams.

Inbreeding has also been followed in poultry work with the only breed kept at Cap Rouge—Barred Plymouth Rocks. For 17 years no cockerels of outside blood were used in the matings. A resume of the results obtained shows that the 1918 matings gave 17 birds of an average body weight of 5·84 pounds, which laid 133·6 eggs weighing 24·1 ounces per dozen; the 1934 matings gave 70 birds of an average body weight of 6·75 pounds, which laid 210·8 eggs weighing 24·5 ounces per dozen. By this breeding method, and by selection and good feeding practices, the weight of birds, and the number and size of the eggs have been increased. It is most interesting, however, to note that in another project started recently by which outside blood is introduced in the flock, the gains in body weight, and in number and size of eggs are much more pronounced.

Horticultural Projects Now Given Prominence

Although live stock is still carried prominently at Cap Rouge, it has been largely superseded since 1933 by horticultural projects, which, with poultry studies, are now featured. The rapid development of the vegetable-growing industry, the ever-increasing number of small-fruit and apple growers in the district served by the station, and the great possibilities of large areas of muck land at a short distance from Quebec city made it imperative that more attention be given to horticultural problems. In co-operation with the provincial Department of Agriculture tests are made in districts where horticultural crops are grown commercially, of varieties, of fertilizer treatments for different crops and different soils, and of the behaviour of certain of the crops in cold storage. The growing of hardy root stocks, begun in 1935, is to be continued on a larger scale, as is the testing of apple seedlings, most of which are creations of the Central Experimental Farm. The production of Elite stock vegetable seed, the use of electric hot beds, and the test growing of shrubs, flowers, hedges and lawns are some of the many undertakings carried on for the ultimate benefit of growers in the district.

EXPERIMENTAL STATION, LENNOXVILLE, QUE.

The experimental station which serves the Eastern Townships and southwestern Quebec was established in 1914 with three sets of ordinary farm buildings; but subsequent alterations and new constructions have developed the present fairly complete station property well situated on the St. Francis river, a mile east of the town of Lennoxville and four miles southeast of Sherbrooke, the chief industrial city of that part of Quebec.

The area of the farm is approximately 600 acres, 450 of which have been broken and underdrained. About a third of this improved land is relatively low-lying, the soil for the most part being a fertile clay loam with a clay sub-soil; on the remainder the principal soil type is a fine loam over-laying a variable sub-soil.

The station maintains herds of beef and dual-purpose Shorthorn and Jersey cattle, for the Eastern Townships area is a noted live stock district. In the dual-purpose Shorthorn herd a number of the females raised have made excellent R.O.P. records and have retained good beef conformation; with the beef herd, beef type is the primary consideration. Work with Jerseys has been mainly the development of a high standard of production and the dispersal of good breeding stock to farmers' herds throughout the district. All cattle are fully accredited and are blood-tested for contagious abortion.

A number of Yorkshire sows raised at the station have been admitted to Advanced Registry. Their progeny has found a ready sale as breeding stock and has done much to maintain and to improve the standard of the breed throughout the Eastern Townships. Sheep breeders, too, have benefited by the sale of many graded rams raised from the flock of Oxford Down sheep that has been maintained since the station was established.

Visitors days are important in the work of the experiment station. This shows part of the crowd at a field day held at the Lennoxville station.

Pasture Improvement Studies Featured Prominently

The station, naturally interested in improving pastures for its live stock, has obtained valuable information from pasture investigations to which approximately 60 acres of land have been devoted. Continuous grazing has here been found superior to rotational grazing. Expensive seeding mixtures are unnecessary, for native species rapidly take possession, and crowd out others that have been seeded. Excessive applications of lime have eliminated wild white clover from pasture sods, but comparatively small amounts of phosphoric acid, along with close grazing, have proved decidedly favourable for this plant, even on decidedly acid soil. Preliminary experiments have indicated that moss hummocks, commonly found in pastures throughout the Eastern Townships, can be broken down and the area thus occupied made productive by the use of nitrate of soda and sodium carbonate.

Other investigations in field husbandry have shown that although after-harvest cultivation is a practical method of controlling perennial weeds such as couch grass, when employed immediately preceding the corn crop it has reduced the yield by about two and one-half tons per acre. Experiments over a period of 14 years have indicated that ground limestone has a value up to $12.00 per ton in increased crop following its application to acid soils. Experiments with fertilizers for hay and grain have shown that on lighter soils, applications of potash are essential for normal plant growth.

Variety tests and the development of new strains of field crops and cereals have demonstrated the varieties best suited to the district served by the station. A highly productive strain of the Ditmars variety of swede turnips has been developed, as well as a number of promising hybrid varieties of oats, barley and field peas. The most satisfactory varieties of these cereals at present available are Legacy oats, Charlottetown 80 barley and Early Blue peas, seed of which is raised each year and sold. It would also seem that suitable varieties of soybeans may now be grown satisfactorily throughout the entire district.

Orchard Problems Investigated

Results from experiments conducted in commercial apple orchards in western Quebec have clearly indicated the value of sod mulch, the necessity for the use of potash and the danger of excessive nitrogen applications. A number of new high-quality seedling varieties, including Melba, Lobo and Lawfam, are suitable for the severe climate of the district.

As a result of ten years' blood-testing, the flock of Barred Rock poultry has been for a number of years classed as pullorum-free. A limited number of day-old chicks, pullets and cockerels are sold each year for breeding purposes.

The apiary, kept for demonstration and experimental work, has shown that the district is a good honey-producing territory and that bees may be kept profitably.

EXPERIMENTAL STATION, FARNHAM, QUE.

The experimental station for the Yamaska valley was established in 1912 on 40·3 acres located in the tobacco district of southern Quebec at Farnham, a border town of the Eastern Townships.

Although its present area of 69·5 acres, all cultivated, carries an Ayrshire herd and enables some experimentation to be done in field husbandry and with sugar beets, the station is highly specialized for cigar-binder tobacco production; its experiments, therefore, are almost all designed for the improvement of this special crop.

Until recently, the station produced almost enough tobacco seed annually to meet the requirements of the district; but with the registration of tobacco seed in 1933, the mass production was turned over to independent growers.

Much attention has been given to the construction and management of seed beds. Permanent A-shaped beds showed many advantages when compared with semi-cold beds, and a special type of hip-roof, permanent bed, built of regular bed sashes, proved successful under the climatic conditions at Farnham. Steaming the beds controlled the soil-borne diseases best, but treating with formalin was more economical and very satisfactory.

Studying Tobacco Diseases in the Field

Diseases and methods of combating them have been further investigated in the field. An intensive study of the resistance of cigar and pipe varieties to black root-rot has been conducted in a field artificially infested with the disease organism. The yield and quality of all varieties were affected, all the pipe varieties being highly susceptible, but one cigar-binder variety, the Resistant Havana, proved very resistant. Surveys of other diseases, such as angular leaf spot, wild fire, and mosaic have been conducted from year to year.

Insect pests have also been studied. Cutworms and grasshoppers, which damage tobacco only occasionally in the district have been controlled by poisoned bran. Wireworms require preventive cultural methods. A recent survey of the district showed that the preceding crops, the date of planting, and the number of ploughings and harrowings were the most important factors in checking them.

The experimental growing of tobacco at Farnham has enabled different cultural methods to be evaluated; level cultivation, for example, has been found practical only on well drained fields while ridge planting is advocated for other locations. Five- and seven-year rotations, with two or three consecutive years in tobacco were advantageous, and experimental planting of tobacco after each of 14 different crops has shown that tobacco is grown most successfully after leguminous plants, such as clover, alfalfa, peas and beans.

The effect of topping and suckering on the yield and quality of cigar-binder varieties was studied. The topping was done high and low at four different stages, bud, early bloom, full bloom and at harvest. Suckering was done once, twice and three times. A low topping in the early-bloom stage, with two suckerings, gave the best results.

A fine field of cigar-binder tobacco produced at the Farnham station.

Tests of about 30 cigar and pipe varieties have shown that for the southern Quebec district, C. S. Pomeroy, Connecticut Havana 38, Pennsylvania Havana and Smith's Seed are the most promising cigar-binder varieties, and Belge, Parfum d'Italie and Little Dutch Ragondorf are the best pipe varieties.

Determining the Effects of Fertilizers on Tobacco

Extensive tests with chemical fertilizers, with and without manure, are conducted on 128 plots grown for that purpose. Of the manures tested in combination with chemical fertilizer, hen and sheep manures were the best, but horse and cow manures are very satisfactory in practice. Tests of different combinations of mixed barnyard manure and chemical fertilizer showed that from 10 to 15 tons of manure per acre with 700 to 1,000 pounds of fertilizer gave the best results—better even than larger quantities of chemical fertilizers alone.

Different sources of the main plant nutrients have been studied. For nitrogen, the combination of nitrate of soda with sulphate of ammonia gave as good results as urea, nitrate of potash and nitrophoska No. 3; and among organic sources, soybean meal was as good as cottonseed meal. For potash, sulphate and nitrate of potash were satisfactory. Sulphate of potash magnesia gives almost the same yield and quality of tobacco as sulphate of potash, and improves

the burning quality. For phosphoric acid, superphosphate was as good as the other sources tested, if not better.

Further tests were made to determine the effect of applying different amounts of these main plant nutrients. Additions in the manure series of from none to 100 pounds of mineral nitrogen per acre showed that the higher the amount of nitrogen the greater the yield and the better the quality. In the chemical fertilizer series, 120 pounds per acre gave the best results. Different quantities of organic nitrogen derived from cottonseed meal were tested: 20 per cent of organic nitrogen from this meal in the fertilizer mixture gave the best results.

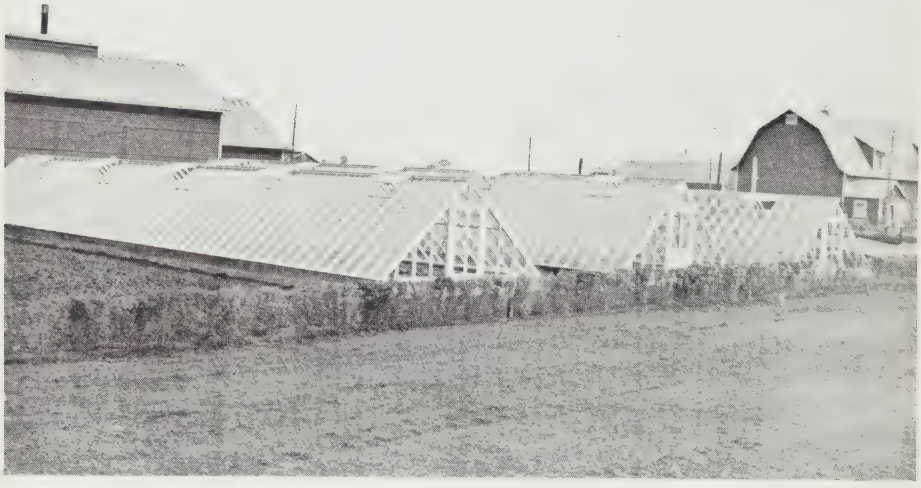
Yield and quality improved with increased quantities of potash, and the same was true for phosphoric acid, except that a limit of 120 pounds was set in the chemical fertilizer series.

Varietal cigar-binder tests and chemical fertilizer trials are conducted on the different types of soil in the district.

EXPERIMENTAL STATION, L'ASSOMPTION, QUE.

The experimental station at L'Assomption, Que., was established in April, 1928, by the purchase of a farm of 150 acres, one mile west of the town of L'Assomption and nine miles east of Montreal island.

The soil of the station is chiefly sandy loam one to three feet deep on two to eight feet of quicksand underlaid with clay. More than 100 acres have been tile drained, but on the northern part of the farm about 50 acres of soil varying from light, sandy loam to very sticky silt are difficult to drain on account of both the quicksand sub-soil and the lack of outlet.



The A-shaped plant bed used for the production of tobacco plants. This type of structure has proved in the long run to be as economical as the ordinary bed besides enjoying certain advantages over the latter type.

So far, tobacco work has predominated at L'Assomption, but the other phases of farm practice are not overlooked, for tobacco is a crop that fits in very well on a dairy farm where a short rotation is followed.

For the disinfection or sterilization of tobacco plant beds, one part of a 40 per cent solution of formaldehyde in 50 parts of water has proved reliable. Two

methods of steam sterilization have been tried, the inverted-pan method and the underground perforated-pipe method. Both are very efficient. Steam sterilization is to be perferred to chemical disinfectants because it destroys not only disease germs but also all weed seeds and causes less delay in the seeding of the beds.

Mosaic disease has been more prevalent in recent years but by good sanitary methods of plant production and by roguing the diseased plants in the field, the damage can be reduced to a minimum.

Black root-rot, a disease that can be found on almost every tobacco farm, can be controlled fairly well by the disinfection or sterilization of the plant beds, but also by a rotation of crops, by growing resistant varieties and by maintaining an acid condition in the soil. On field with a pH of more than 5·6, black root-rot injury is likely to be prevalent. On the other hand when the soil is more acid than pH 4·8, the yield and quality of the tobacco are likely to be affected adversely.

Variety Tests with Tobacco

More than 50 varieties or strains and 30 hybrids have been tested. In the cigar-binder type, Comstock Spanish remains the favourite variety whilst when grown on the right kind of soil the Connecticut Havana No. 38 produces the best cigar-binder tobacco. Petit Havane and Canelle are still the best of the small aromatic pipe tobaccos; Parfum d'Italie, Belge 3007 and Grand Rouge are the most popular varieties of large pipe tobacco. The last is a strain developed by the station from a mixed variety.

A fertilizer mixture which increases the yield may produce tobacco of poor quality. Quality in tobacco embraces many factors; colour, elasticity, thickness, finish of the leaves, taste, good burning, etc., and the fertilizers may affect any of these.

For a crop of cigar-binder tobacco, the local recommendation, based upon experimental evidence, is 150 to 160 pounds of nitrogen, 150 to 160 pounds of phosphoric acid and 250 to 300 pounds of potash per acre.

It was long thought that the use of cottonseed meal as a source of organic nitrogen was essential, but when ten to twelve tons of farm manure are used in combination with mineral fertilizers, very good yields of excellent tobacco are produced.

Experimental work has shown the importance of the sources from which the fertilizing elements for cigar-binder tobacco are derived. For instance, it seems to be well proved that 30 to 40 per cent of the nitrogen should come from organic sources. An excess of phosphoric acid is harmful to the burn and general qualities of the tobacco. It has been determined that chlorine impairs the burn. When as little as ten per cent of the potash fertilizer is derived from muriate of potash, decidedly adverse effects on burn have been noted. The sulphate form of potash should be regarded as the main source of this element for the cigar tobacco crop.

In flat cultivation the fertilizers are proving slightly more effective when they are drilled in the row of tobacco. If tobacco is to be grown on ridged soil, the best method is to broadcast the fertilizers, then to harrow the soil and make the ridges.

Experiments have shown that two suckerings should be made, the first when the suckers are about four inches long and the second at harvest, and that the tobacco should be topped in the advanced-bud stage, or just before the first flowers open.

Growing of Flue-cured Tobacco has Possibilities

Four years of experiments have shown that the production of flue-cured tobacco is possible in this district although its economic feasibility remains to be determined. The soil remains cold too late in the spring to favour an early

growth of tobacco and the cold nights and damp weather at the end of August and in September delay too much the ripening of the crop. However on suitable soils with low water table and located away from swamps or large areas of wet soil which are often associated with early frosts, the growing of early varieties of flue-cured tobacco promises to be successful where early planting can be done and the best cultural practices are followed.

Demonstrations and lectures put on by the station in many different places have been responsible for great improvement in the methods of harvesting, curing and stripping tobacco. Moreover, four illustration fields including 12 to 32 plots are used to check the results obtained experimentally on the station.

The herd of Holstein cattle was established in the spring of 1929 by the purchase of a fairly good bull and five cows of rather inferior type and has been gradually built up to an average production of more than 11,340 lb. of milk and 408 lb. of butterfat per cow. Although the average cost of feed per 100 pounds of milk produced has been around $0.64 for the last four years, it goes down to $0.20 or lower when the cows are on good pastures.

Methods of Weed Eradication Investigated

Most of the soil is acid but liming at the rate of two tons of crushed limestone per acre has resulted in heavy crops of alfalfa hay. The station farm was known to be one of the most weedy. Wild mustard in many fields grew in thick mats, sometimes smothering the oats. Clean hoed crops coupled with spraying of the oat fields with solutions of copper sulphate are rapidly cleaning this weed out of the farm.

Of the eight varieties of silage corn which have been grown for a few years, Wisconsin No. 7 has been reliable, with an average yield of more than 18 tons per acre. For the production of husking corn Quebec No. 28 seems the most promising. In field culture it has yielded at the rate of 67 bushels of shelled corn per acre.

The Manitoba Brown soybean, with an average yield of 23 bushels per acre, is sure to mature, but its low habit of growth makes it difficult and costly to harvest. Furthermore, the trade does not like the brown colour. The Mandarin, which takes at least two weeks longer to reach maturity, must be planted early, but will yield as high as 30 bushels per acre.

EXPERIMENTAL STATION, HARROW, ONT.

Some of the early experimentation with Canadian tobaccos was begun in 1909 on a 50-acre tract of leased land, called the Harrow tobacco station, in Essex county in the extreme southwestern part of Ontario. In 1923 this original property was purchased and enlarged to 200 acres so that the station, now raised to the status of an experimental station, could widen its sphere of investigation to include work with forage crops, particularly corn and soybeans. Field husbandry, cereal and horticultural investigations soon followed, and later its activities were further increased by the addition of a poultry plant and a small herd of accredited Jerseys. The Harrow station is suitably situated and equipped for conducting experimental work on the many specialized crops grown in the southwest peninsula.

Moreover, with the development of the tobacco industry in Norfolk, Oxford, and Elgin counties—known as the 'new belt'—a sub-station was established in the vicinity of Delhi, Norfolk county, Ont., in 1933. The entire 50-acre area of this sub-station is devoted to experimental plot work with flue-cured tobacco.

Experiments Cover Whole Field of Tobacco Culture

Experimental projects at Harrow and Delhi now cover virtually every phase of tobacco culture of value or interest to the tobacco growers. These projects include improved methods for the production of tobacco seedlings;

cultural practices in relation to spacing, topping, and suckering of the crop; cultural practices dealing with methods of applying fertilizers and manures, time of ploughing and general soil management; crop rotations; fertilizers; varieties and breeding work; disease and insect pest control; methods of harvesting in relation to maturity; humidity and temperature relations in curing; and bulking, grading, and storing tobacco.

Plantbed studies have resulted in improvement in construction and management of plantbeds throughout the district, particularly among flue-cured tobacco growers. As a result of tests, growers are sowing less seed and are producing better plants with less trouble from plantbed diseases. Steam sterilization of plantbed soil is now an accepted practice in controlling soil-borne diseases.

Experiments have shown that spacing of tobacco in the field has a direct influence on the maturity, yield, and quality of cured leaf. Closer planting, higher topping, and less frequent suckering are now practised in the production of cigarette tobacco, as compared with wider planting, lower topping, and frequent suckering for the heavier tobaccos.

Fall ploughing has proved preferable on the heavier soils, while better results have been obtained with early spring ploughing on the lighter flue-cured tobacco soils. Applications of barnyard manure in combination with commercial fertilizers have been found superior to either barnyard manure or fertilizer alone, particularly for burley and dark tobaccos. Short rotations have become necessary on sandy soils to control mosaic, but a long rotation or a resistant variety is necessary to control black root-rot on the heavier soils.

Meeting the Changing Requirements of the Industry

During the past decade the tobacco industry has undergone definite changes in leaf requirements. Previous to 1930, Broadleaf burley was widely grown, but a demand for a brighter and finer type of leaf popularized Station Standup for four or five years. This variety was replaced by Standup Resistant, which in turn has given place to still lighter cigarette burley varieties of superior quality, such as Halley's Special and Harrow Velvet. A similar change has

Tobacco grown on soil infested with black root-rot. Harrow Velvet, a resistant variety developed at the Harrow station is in the two rows at the left with the variety Judy's Pride on the right.

taken place in flue-cured tobacco: Warne and Hickory Pryor, which formerly were grown exclusively, have been entirely replaced by more erect varieties suitable for priming, such as White Mammoth, Yellow Mammoth, Bonanza, and White Stem Orinoco.

With each advance in the type of leaf required, the station at Harrow has carried on sufficient breeding and selection work to keep up a supply of seed suitable for the particular demand. Of new strains developed from time to time showing resistance to black root-rot, Standup Resistant and Harrow Velvet are outstanding examples.

Experiments in curing tobacco, particularly in temperature and humidity relations which are vital to the colour and texture of the leaf, and in the effects of maturity, have aided the grower in obtaining a more satisfactory product.

In forage crop work particular attention has been given to corn and soybeans.

The European corn borer almost eliminated corn work during the years of greatest infestation, but now that the danger has been reduced considerably this work is again being extended. A test under corn-borer conditions showed that a medium early-maturing strain of corn with a sturdy stalk planted about June 1 gave the best yields with the least damage done by corn borers. Earlier plantings were subject to an increase of approximately 50 per cent in infestation, and later plantings, particularly of later-maturing varieties, were unlikely to mature before frost.

Inbred strains of corn have been maintained over the entire period and the number is now being increased. Single and multiple crosses are made between these inbred strains and the progeny is tested. Hybrid strains are also being developed in an effort to raise the yield of corn in the district.

Studies with Soybeans

Comparatively new in the district, the soybean shows promise of becoming important. First-generation registered seed of one selection, the A.K. (Harrow), produced at the station is now available. It has proved to be the highest yielder of beans and oil per acre of any under test. New hybrids are created each year. About 900 selections of hybrids and introduced lots are grown annually and compared with a standard variety.

Some of the better strains of sugar beets are being tested in co-operation with the Canada and Dominion Sugar Company and the possibilities of producing sugar-beet seed are also being studied with promising results.

During recent years increasing attention has been given to important horticultural crops in the district. The work in cereal crops consists principally of variety tests of winter wheat and oats. The Dawson's Golden Chaff type of soft winter wheat appears most suitable to the trade. Alaska 157 is outstanding as an early oat particularly adapted to the lighter soils of the district.

Modern equipment for about 400 Barred Plymouth Rocks and a laying contest house for 36 pens were provided in 1930 to meet a request from a number of poultry men of western Ontario that a laying contest be held in this favourable district. Selective breeding has developed a poultry flock that shows marked prepotency for high egg production and size of eggs in some family groups. At the same time progress has been made in the improvement of body weight, texture of egg shell, and the type and colour of plumage.

EXPERIMENTAL STATION, KAPUSKASING, ONT.

The Kapuskasing station is a pioneer institution in a pioneer country. Prior to its establishment in 1914, a few isolated settlements on what is now the northern line of the Canadian National Railways transcontinental system were demonstrating that clearings in the virgin coniferous forest could be developed

into farming lands. The Dominion Department of Agriculture decided to establish an experimental station to promote development of this northern country and to stimulate its settlement. A site was chosen where the railway crossed the Kapuskasing river, and here the thriving town of the same name has grown up. Preliminary land clearing was undertaken in co-operation with the Department of National Defence, which utilized the station as a prison camp for interned aliens, the first of whom arrived on Christmas Day, 1914.

The climate of the region, which lies on the James bay watershed, is rigorous, with long, cold winters, deep snow, and short, cool summers. Frosts occur late in the spring and early in the autumn, but during the last 18 years the average length of the frost-free period has increased from 47 days, the average for the first six years, to 101 days, the average for the six-year period prior to 1936. Thus with progressive clearing of the land, crop maturity has become safer.

Rainfall is adequate and well distributed, although sometimes an autumn excess makes harvesting difficult.

A New Technique in Soil Drainage

The soil of the northern Ontario clay belt is predominantly heavy, with areas of muskeg and limited areas of lighter loam and sandy soils. The station soil is typical, being a heavy clay with small areas of muskeg, drained, however, without much difficulty. The gently rolling topography characteristic of the

The Kapuskasing station from the air. The heavily wooded character of the surrounding district is in sharp contrast to the well-tilled station fields.

region facilitates the establishment of surface drainage through a system of permanent 'lands' rounded up by ploughing. This system, developed in the province of Quebec, works very satisfactorily at Kapuskasing, and has the advantage of requiring no expense for its establishment beyond the regular ploughing of the fields. Experimental work has shown that while underdrainage gives slightly greater yields than this system of surface drainage the increase would be insufficient to justify the capital outlay. Widths of 48 to 60 feet per land have been found very satisfactory.

The station is well equipped with buildings. The majority are built of dressed lumber, but log construction has been tried for two small barns and several poultry houses. Built of native spruce logs and carefully chinked with either mortar or moss and mud, these buildings have proved entirely satisfactory.

As this station is located in a pioneer district it has been basically engaged in determining what can and what cannot be grown in the region. Soon after its inception, fields were prepared for experimental work, and they have been added to as the scope of the work enlarged until today about 200 acres are devoted to intensive or extensive experiments with field, vegetable and orchard crops, cultural practices, rotations of crops, fertilizer and manurial treatments and pasture trials.

Recommended varieties of cereals are Reward and Garnet wheat, Alaska and Cartier oats, O.A.C. 21 barley, and Early Blue and Chancellor field peas.

The value of alfalfa and late or single-cut red clover in improving the quality and quantity of hay has been demonstrated. Alsike and late red clover are profitable seed crops at Kapuskasing but early, or double-cut red clover is not. Rotations of five or six years' duration have been more profitable than shorter ones of three or four years, but under the longer ones the land tends to become weedy. Commercial fertilizers, especially those bearing phosphate, have proved of value.

Horticultural Possibilities

Hardy varieties of crab apples thrive in the climate, but ordinary apples will not. Raspberries, strawberries and currants grow well and the yield of such vegetables as cabbage, peas, beans, celery, lettuce, carrots, beets, spinach, onions, radish and potatoes is high and the quality is excellent.

About 400 acres in addition to the experimental fields have been brought under cultivation. This acreage is used for growing hay, grain and pasture for the live stock.

Both dairy and beef cattle are maintained. In the pure-bred Ayrshire herd the average annual milk production per cow has increased from 7,599 pounds in 1924 to 9,733 pounds in 1935, an increase of over 28 per cent. With the beef herd of pure-bred Shorthorns bred for both beef and milk, great advance has been made. While the beef type has been maintained, milk production has been increased from 5,161 pounds per cow per annum in 1930 to 7,053 pounds in 1935, or more than 36 per cent.

The pure-bred Yorkshire herd has proved that swine will thrive in the northern climate on feeds grown in the district.

Experiments in housing and feeding with Barred Plymouth Rocks show that from a flock housed in inexpensive but properly constructed buildings and fed on grains grown locally, very good returns may be obtained. The use of snow instead of drinking water has been found entirely satisfactory.

Kapuskasing is exceptionally well located for work with bees, there being no others, either wild or domestic, within a radius of many miles. Advantage is taken of this unique opportunity for queen breeding. The average annual yield of extracted honey for nine years has been 187 pounds of excellent honey per colony. Wintering losses have been less than ten per cent.

EXPERIMENTAL STATION, MORDEN, MAN.

Situated at the eastern edge of the town of Morden 12 miles from the United States boundary, the Morden experimental station serves the southern part of Manitoba in general agriculture; but its main purpose is to aid Prairie Canada in the development of horticulture.

A 300 acre farm of sandy loam, typical of much of the prairie soil, was purchased in 1914, and experimental work in general agriculture began in 1916.

This acreage was increased in 1929 to 612 acres, 176 of which are now devoted to horticultural projects.

All available commercial varieties of fruits which promise even a fair chance of succeeding have been planted at Morden, an effort that has guided thousands of prairie growers to select only those new varieties that have proved themselves of local value.

Intensive Search for Hardy Fruit Varieties

The Morden station serves as the main prairie trial grounds for fruit varieties introduced by the Central Experimental Farm, Ottawa. In 1916, 25,000 young seedling apple trees from apple seed of Russian and Minnesota origin were received from Ottawa. The trees began to bear in 1921, and by 1936 a large percentage had produced fruit. Nearly one thousand, considered of special interest, were propagated for retest, and subsequent proving caused 17 to be named and many others to be deemed worthy of continued interest. Many possessed distinctive merit over their mother parents. This planting of seedling apples has drawn students and home-maker visitors from far and wide and has done much to stimulate fruit growing on the prairies. Seed taken from the seedling block has been the source of more than a million apple trees started in prairie plantations.

Apple picking time at the Morden station during the 1933 season.

From controlled fruit breeding, sandcherry, plum, cherry, apricot, apple, pear, and grape hybrids have resulted. A few have been introduced, and from extensive populations now under appraisal many new fruits of value are expected.

Problems peculiar to prairie conditions, such as windbreak arrangements, determining plant types resistant to drought and to winter cold, and methods of preventing injury from rabbits, mice, and sunscald, receive special attention.

Seed samples in season are supplied free to all requesting them. Scions, budwood and cuttings in moderate quantity are sent to persons from northern Quebec to British Columbia. Tens of thousands are mailed each season. Nurs-

ery stock is not sold or provided to the general public, but experimental stations, illustration stations, and a limited number of widely distributed, select co-operative growers are sent fruit stock for demonstration and test purposes.

New vegetable varieties and novelties are tested, and cultural trials are conducted with important crops as tomatoes, melons, corn, celery and pole beans. Breeding work has been chiefly confined to tomatoes and melons.

Trees, shrubs, vines and flowers have been set out in a prairie system of landscaping. Lines are mostly flowing rather than straight, and subjects are set in islands along the drives, and at fitting parts of the lawns. A large number of useful new exotic plants have been introduced.

Particular mention should be made of roses as several thousand hybrids have resulted from controlled breeding. Advances are recorded in hardier pillar and perpetual hybrids and in more colourful bush roses.

A prairie arboretum is being built up. More than two thousand species and varieties of trees, shrubs, and vines have been assembled, some of the most serviceable coming from northeastern Asia.

Many New Varieties Introduced

The station has contributed 94 new varieties to prairie horticulture since 1929. Of these 77 are fruits including 51 apples, 17 plums, 3 sandcherries, 4 sour morello cherries, 1 crab apple, and 1 apricot. The ornamentals include 10 roses of controlled breeding, 1 double-flowering pincherry, Stockton, 1 red elder, Redman, 4 hybrid late lilacs, Coral, Nocturne, Redwine and Royalty, and 1 gladiolus, Morden Maid.

Sixteen apples are Mantet, Mortof, Manton, Manan, Manred, Moris, Spangelo, Godfrey, Manitoba, Manitoba Spy, Stevenson, Watts, Breakey, Morden Russet, Ostem and Redant. Their season ranges from October until May. All came from the original seedling block. The crab apple, Toba, is from a cross, Rosilda × Angus, both parents being second-cross apple-crabs bred at Ottawa.

Three plums are Mordel, Mordena and Mina. Three sandcherries are Manmoor, Mando and Mansan. The last-mentioned is a natural hybrid, the mother parent being the native sandcherry, the pollen parent, a plum. One of the sour cherries is a seedling of Vladimir, the other three are second-generation selections of Shubianka. All four trace back to importations from Russia. The apricot, selected from a group of Manchurian origin, has continued hardy. The fruit is of medium size and pleasing quality.

Stockton pincherry is a double-flowered wildling from the sandy hills near Stockton. Redman elder makes a shapely bush, fruitful, and adorned with gracefully cut leaves. The hybrid lilacs carry *reflexa* blood and are selected on colour: Coral, clear pink; Nocturne, hazy mauve; Redwine, glowing maroon red; Royalty, rich purple.

In addition to its main activities in horticulture, the station conducts experimentation in general agriculture for the benefit of those districts that come within its sphere of influence. Its Percheron horses, Ayrshire cattle, Hampshire sheep and poultry flocks supply foundation stock to farmers. The station has promoted the use of field corn, which locally in recent years has to a large extent displaced summer-fallow. Local selections have won esteem for earliness and dry-matter content.

EXPERIMENTAL FARM, BRANDON, MAN.

The Brandon experimental farm, one of the first five established in the system, consists of about 300 acres of high land and 550 acres in the Assiniboine valley, the latter acreage being within the city limits of Brandon. The first superintendent demonstrated so ably the value of trees for shelter and ornamental

purposes that the arboretum with its southern exposure, a real testing place for hardiness for thousands of shrubs and trees, is now a wonderful contrast to the bleak hillside of 1889. In recent years the experimental horticultural work has been transferred to the Morden station; only demonstration gardens continue at Brandon.

Crop Rotations Suited to Prairie Farms

From the beginning, crop rotation has been an important phase of the work at this station, and while in early years information was rarely asked for, today Manitoba farmers are realizing the value of suitable crop rotations in adding fibre to the soil and in controlling weeds and insect pests. Thus the work of a generation is bearing fruit, since it can be shown from different experiments that under the soil conditions existent in western Manitoba the introduction of grasses and legumes into rotations can be made to control effectively such weeds as wild oats, and that cultivated grasses add soil fibre and create a granular soil structure.

The demand for information on commercial fertilizers was not foreseen so far in advance, for previous experiments using eastern methods of application indicated that western soils did not respond to applications as freely as those in moister districts. A new development in application whereby the fertilizer is deposited in small quantities with the seed, showed increased growth and often increased the crop yields.

As the early settlers were confronted with the problem of how to cultivate the land for good crop yields, an extensive set of experiments was launched in 1911 to determine how to prepare both native sod and cultivated land for crops. Many vexing problems have been solved thereby.

Of the many cereal varieties introduced into Canada by the Dominion Experimental Farms in earlier years, few, if any, equalled Red Fife wheat, Banner oats or Mensury barley. A number of the introductions, however, proved valuable as parents in cross-breeding work at the Central Experimental Farm, and the Brandon farm took part in testing the new varieties—including Marquis, Stanley, Preston and Reward—which were developed from this work. The increasing prevalence of rust and the demand for better varieties made it imperative to breed cereals less susceptible to the ravages of rust. The Brandon farm now has a number of hybrid strains of wheat and barley that are resistant to rust and that give promise of proving useful in western agriculture. Much progress has been made in the breeding of a rust-resistant, smooth-awn barley with a stiff straw and with good yielding capacity. In recent years the production of Elite stock seed for sale to farmers has superseded the growing of registered seed. This foundation material is supplied only to some of the best seed growers in the province.

Progress Made in Forage Plant Breeding

Since 1924 plant breeding has been well to the fore in forage crop work. An early strain of Northwestern Dent corn has been produced and is still being improved, and a dwarf strain of white sweet clover is in the final testing stages. A yellow-blossom sweet clover, with upright-growing lower branches, has been developed. This new variety yields quite as well as Arctic, the standard white-blossom sort, and is a week earlier. It should prove useful to Manitoba farmers as it will permit earlier haying and, consequently, longer summer-fallowing.

As the pasture problem is acute on most Manitoba farms, investigations are under way to determine suitable species and mixtures. So far, a combination of brome and alfalfa has proved the most promising. The growing of forage-crop seeds is stressed, every effort being made to interest farmers in growing the seed for use on their own farms.

When the breeds of cattle were allotted to the different experimental farms the animals selected for Brandon were descendants of a Shorthorn importation from England made in 1901. Very few additions were made to the herd and no females have been added in recent years. Accurate records have been kept of the milk production of each cow. The highest is 14,082 pounds testing 4·14 per cent butterfat. The highest yearly herd average, 7,568 pounds, was reached in 1934. The average production of all cows during the past 15 years was approximately 6,000. Few females have been sold as breeders, but 200 bulls have been

A group of steers of dual-purpose Shorthorn breeding marketed from the Brandon station in June, 1936.

sold to head Shorthorn herds in Manitoba. For more than 25 years winter steer feeding has been carried on at Brandon and the information obtained has proved useful in various parts of the West.

A herd of 20 Yorkshire brood sows is maintained. The objective at present is to develop a strain of prolific, early-maturing hogs of correct bacon type by testing the progeny of the various sows. A recent addition to the herd is a group of six sows and one boar of the Landrace breed. These are compared with the Yorkshires for the production of bacon under Manitoba conditions.

Poultry Flock Responds to Improvement Program

The poultry industry during the past 50 years has been completely revolutionized. The high price for winter eggs has created a demand for early chicks that is extremely difficult to satisfy. Less than 25 years ago the poultry at the farm consisted of few birds of each of several breeds housed in a small building. Now a Barred Rock flock of several hundred hens and pullets is kept. Breeding operations have been directed toward the development of a strain possessing the essential characteristics of utility farm poultry. In extensive feeding experiments barley has been proved to be equal in value to corn. This is an important discovery, as barley is one of the main farm-grown feeds, while corn has to be imported. During the past eight years, hatching results at Brandon have been improved 50 per cent, and mortality of brooder chicks has been reduced from 40

to approximately 3 per cent, largely by blood testing and improved sanitary conditions.

Bees, introduced on the Brandon farm in 1889, were continued in a small way until 1920 when the equipment was transferred to the Morden station, where bees were required for pollination purposes. Because many bees were lost through poisoning by sprays, the experimental apiary of almost 100 colonies was transferred back to Brandon in 1934. In the two years the apiary has been at Brandon, western beekeepers have shown a very active interest in the experimental work.

EXPERIMENTAL FARM, INDIAN HEAD, SASK.

In the early history of Saskatchewan agriculture comparatively little was known regarding the potential agricultural wealth hidden under the vast stretches of unbroken prairie. When the Indian Head experimental farm was established

In 1890 the superintendent's house at Indian Head stood exposed to prairie sun and wind. Now it is surrounded by these fine trees and hedges.

in 1887, experiments were set up to secure information on the value of good seed and on the suitability of varieties, on rotations and on cultural methods. Summer-fallowing, practised at that early date, continues to be the most profitable method of ensuring a satisfactory crop. The settlement of the prairies and the development of a more permanent agriculture brought with it a change in cultural

practices, the introduction of improved farm machinery, and new and suitable varieties of grains and grasses. The development of live stock and mixed farming found favour in many sections considered unsuitable for wheat farming. Research work in animal husbandry, cereals, forage crops, rotation and cultural methods, horticulture and poultry has been carried on to secure reliable information on every phase of agriculture.

Live Stock Projects at Indian Head

Breeding and experimental work with live stock has held an important place at Indian Head during the past 25 years. Clydesdale horses are maintained for work, breeding and experimental purposes. Farm-bred horses have been consistent winners at the Royal Winter Fair and other exhibitions. Considerable progress has been made in the control of joint-ill in foals. Shorthorn and Ayrshire cattle have been maintained for the production and selection of superior beef and dairy strains as well as for experimental feeding projects. A herd of Yorkshire swine of excellent bacon type has been developed. In addition to conducting Advanced Registry and experimental feeding work, the farm supplies breeders with good breeding stock.

The Saskatchewan Egg Laying Contest has been conducted at Indian Head for the past 17 years; during this time it has stimulated interest throughout the province in the breeding of high-producing poultry as well as in improved methods of feeding and housing. A small flock of White Wyandotte and Barred Rock poultry has also been kept for breeding and experimental purposes.

The work in field crops has kept pace with changing needs. Through the years this farm has occupied an important place in the increase and distribution of new varieties and high-quality seed. Indeed, some progress is being made in the production of earlier-maturing, better-yielding and better-quality sorts with almost every cereal crop suited to Saskatchewan conditions, and much has been learned regarding the growing and handling of crops such as alfalfa, sweet clover and some of the grasses. Tests over a period of years have demonstrated the futility under local conditions of broadcasting commercial fertilizers to increase crop yields. Investigations relating to pastures reveal that of the cereal grains, oats yield a greater quantity per acre of dry matter and protein than barley, wheat and spring rye, and that young oats may be regarded as a highly concentrated protein feed.

Fruit Growing Possibilities Investigated

During the past 50 years the growing of fruits on the prairies has advanced from the nebulous state to the point where it is possible to recommend varieties with some degree of assurance that they will grow and fruit from year to year. Hardy varieties of crab apples suitable for prairie culture have been originated and large apples are about to become a reality. Plums, too, have been improved; the most promising thus far are selections of the Manitoba native. Plum-sand-cherry hybrids are not reliably hardy.

The demonstration beds of annual and perennial flowers and the vegetable garden are popular with visitors to the farm. As the vegetable crops are grown without artificial watering, the cultural and varietal tests conducted demonstrate clearly what can be done. Protection of some sort is essential, and if no permanent shelter is available, hemp or sunflowers seeded annually give excellent results.

EXPERIMENTAL SUB-STATION, REGINA, SASK.

This sub-station has been in operation since 1931 with the primary purpose of studying weed control, soil-drifting control and other crop production problems on the heavy clay soil type known as "Regina clay" which forms an area of about 1,500,000 acres between Tugaske and Weyburn.

Wild mustard infestation is widespread and severe throughout most of the area, with lesser and varying amounts of stinkweed, wild oats and other annuals. Canada thistle was very common a few years ago, but recent dry years and other control factors have combined to reduce the infestation very materially. Couch grass and poverty weed are also found in scattered areas in the district.

Weeds in Relation to Crop Yield

The largest single project under way is a combined study of the effect on crop yields and wild-mustard control of different rates, dates and depths of seeding wheat, oats and barley; the use of phosphatic fertilizer with wheat, and various treatment modifications of these main tests. Results from this project have consistently shown that a heavier rate of seeding than has been the common practice in the community has resulted in increased yields and lessened weed growth. The use of phosphatic fertilizer has had similar results. Early sowing of wheat has generally given the best results, and late seeding has usually been better than the mid-season dates; but the absence of fall frosts during the years when these tests have been made has to be kept in mind in considering these results. The effects of different dates of seeding oats and barley have not been so definite; apparently the type of season is a factor that modifies results considerably.

Work has been done on the spraying of crops with sulphuric acid and with copper sulphate for the control of wild mustard, and although results show economic advantage under heavy infestation, the somewhat costly outlay for material and equipment works against farmers becoming very interested.

Experiments with different methods of summer-fallowing to control Canada thistle showed that a fallow kept entirely black throughout the growing season resulted in a complete kill, but as this practice was particularly conducive to soil drifting the project was rearranged; since then the work has shown that it is possible to achieve practically complete control if the fallow is kept black from the middle of July to about the middle of September, thus reducing materially the cost of the fallow operations and also considerably lessening the danger of field damage from soil drifting.

To secure definite information on the viability and germination habits of the seeds of the different weeds common in the district, a comprehensive project was commenced on the inception of the sub-station, and has been maintained and added to since.

Tying the Soil to the Farm

A considerable proportion of the field area is devoted to projects for the study of soil-drifting control, including such matters as the working of fields in strips of different width; the use of cover crops, including the kind of grain, the date of sowing and the effect on the yield of the subsequent crop; the utilization of crop residues and the addition of straw to form a so-called "trash cover"; the effect of various methods of tillage and the influence through the addition of fibre to the soil, of the growing of hay crops. Although the comparatively short time that these projects have been under way and the absence of extremely bad drifting conditions in recent years does not allow as yet the drawing of too definite conclusions, it would appear that in farming practice no one of the remedial suggestions can be entirely depended on under all conditions, but rather that such practices should be followed as appear best suited to varying conditions.

In addition to the projects mentioned, a number of crop management experiments are carried on which are giving useful information on various aspects of cropping procedure on these heavy clay soils.

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FOREST NURSERY STATION, INDIAN HEAD, SASK.

Two miles southwest of the town of Indian Head, Sask., is the Dominion forest nursery station, established in 1903 by the Department of Interior to produce and distribute hardy nursery stocks of trees suitable to withstand prairie conditions. Owing to the great demand for assistance of this nature the nursery area had to be rapidly increased. In 1931, after the natural resources had been turned over to the Western Provinces by the Dominion Government, the nursery station became a part of the Dominion Experimental Farms System.

The three quarter-sections of school land comprising the property were all virgin prairie, and were acquired successively in 1903, in 1906 and in 1910. Some breaking was done in the summer of 1903 and the first buildings were erected in 1904.

A block of Manitoba maple seedlings at the forest nursery station, Indian Head, Sask.

The soil is generally a light clay loam but rather uneven, with several scattered areas of alkali and considerable surface stone. The topography is somewhat rolling, broken by occasional sloughs and small aspen poplar bluffs. A substantial dam was constructed across a deep ravine under the old Northwest Territories irrigation scheme. This dam generally holds a considerable body of water which furnishes a good supply for an overhead irrigation system for gardens and evergreen propagation plots.

In 1913 another nursery station was established at Sutherland, near Saskatoon, Sask. The administration of these two nursery stations was centralized at Indian Head, office accommodation being secured in town by renting suitable quarters. To keep up with the development it was found necessary to provide a special office building, which was erected in the town of Indian Head in the autumn of 1919.

Millions of Trees for Prairie Planting

The annual tree distribution soon assumed very large proportions. In 1916 more than 4,000,000 seedlings and cuttings were distributed; in 1917, more

than 7,000,000. Since that time the yearly distribution has run from 4,000,000 to more than 7,000,000. In 1935 it was approximately 6,500,000. This material has been available to all farmers living in the prairie region of the provinces of Manitoba, Saskatchewan and Alberta. The total distribution, including 1935, from both nursery stations, was 145,700,000.

Approximately 100 acres on the Indian Head station are devoted to the production of nursery stock, 70 acres to permanent plantations, and about 15 acres to ornamental grounds, orchards, gardens, etc.; the remainder is in roads, pastures, cropland and a considerable area is occupied by bluffs and ravine.

The broadleaf seedling stock propagated for distribution consists of caragana, Manitoba maple, green ash and American elm. Cuttings are produced of hardy poplars and willows. Of the evergreen varieties, propagation is limited to native white spruce and Scotch pine.

With the exception of Manitoba maple, which needs only one year, the other broadleaved varieties require two seasons in the propagating plots before they reach sufficient size to be sent out.

The evergreens stay two or three years in the seed beds; then they are moved to the transplant plots, where they remain for from two to four years.

Collection of maple and ash seed in considerable quantities is made each season in the Qu'Appelle valley north of Indian Head. Elm seed is secured sometimes from Winnipeg or else is produced on the nursery. Caragana seed is produced on the nursery station. White spruce seed is secured from the native stands in either Manitoba or Saskatchewan. Scotch pine seed is purchased in Europe from collections made in central Sweden or Finland.

Small plots of all varieties of trees hardy under prairie conditions are maintained for demonstration purposes. Tests are made of exotic varieties when seeds or small plants can be obtained from time to time. One of the most promising of these is the Siberian larch, which has made splendid development in the plantations both at Indian Head and Sutherland. Several sample hedges of hardy shrubs have been set out for demonstration.

Approximately 70 acres have been planted to permanent plantations varying in size from one-half to four acres, made up of different varieties in varying mixtures. The object was to determine the labour cost of establishment, find out the best mixtures and keep a record of the returns in the way of fence posts and fuel. Measurements are made from time to time in these plantations to determine the relative rates of growth of the different varieties.

Conifers Give Best Results

Generally speaking, from the standpoint of permanence, shelter and wood production, over a period of years the coniferous varieties have proved much superior to the commonly grown broadleaf kinds. The native elm and ash are the only two broadleaved varieties that seem to have any degree of permanence and drought resistance under average upland prairie soil conditions, although the Manitoba maple has given very good results. The Scotch pine and Siberian larch plantations have proved up to the present most productive, while the spruce is most efficient as a shelter.

The ornamental grounds consist of a main approach bordered on either side by massed shrub plantings, lawns and shrub groups around the buildings, a very good perennial border, and a vegetable and small fruit garden such as might be maintained on any prairie farm.

In the early years when little was known about what plums and apples could be grown on the prairies, so many enquiries were received regarding possibilities in this line that a small orchard was laid out for test and demonstration purpose. Many varieties of plums and standard apples have proved successful and the orchard is always a feature of great interest to visitors. More than 30

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varieties of plums and hybrid cherries, 28 varieties of standard apples, and 15 varieties of Dr. Saunders' crosses and crab type apples are now growing and fruiting more or less regularly at the station.

FOREST NURSERY STATION, SUTHERLAND, SASK.

The Dominion forest nursery station at Sutherland, Sask., started in 1912 as a branch to the Indian Head Forest Nursery Station, is situated on No. 27 Highway, six miles northeast of Saskatoon, on 320 acres owned by the Crown and 80 acres of rented land.

At the time that the 320 acres were purchased, the land was badly infested with noxious grasses and other weeds. By a system of tillage which dried out the land the noxious grasses were eliminated, but, following this, in 1914, soil erosion by wind occurred for the first time. To overcome the soil drift, strips of fall rye 70 feet wide and 70 feet apart were seeded in 1914. Tree seeds were sown in the strips of cultivated land between the strips of fall rye, and the results were most successful in two ways: there were abundant crops of tree seedlings, and strip-farming for the protection of farm crops from soil erosion on the open prairies was here introduced for the first time.

The first tree planting was begun in 1913, when four rows of different trees were set out for a distance of two miles along the outside fences. Today, 23 years later, only the rows of caragana and Manitoba maple remain. The other rows which were made up of red willow and Russian poplar died out several years ago.

The first shipment of free trees to farmers was sent out in 1916. From 1916 to 1936, the Sutherland station has sent out 59,366,425 seedlings and cuttings to 57,884 rural applicants in the Prairie Provinces and in the Peace River Block of British Columbia.

Tests with Coniferous Trees

For testing purposes six kinds of coniferous trees were set out in 1914. Siberian larch *(Larix sibirica)*, a deciduous tree, is the fastest-growing of the conifers. It withstands the climatic conditions of Saskatchewan well. It is attacked occasionally by larch sawfly, which is easily controlled by spraying with arsenate of lead.

Native tamarack *(Larix laricina)*, another deciduous conifer, does not grow quite so rapidly as the Siberian larch. The tamarack, like the Siberian larch, is susceptible to attacks of larch sawfly.

Scotch pine *(Pinus silvestris)* is an evergreen of which there are many strains growing in European countries. The strains most suitable for prairie planting are found in northern Europe, and seedlings grown from seeds produced in northern Europe grow into straight, well-balanced and symmetrical trees of good height and girth. Seeds grown in southern Europe produce very crooked trees when grown on the prairies.

White spruce *(Picea canadensis)*. The spruces are found in large quantities from Atlantic to Pacific, and each geographic division of Canada has a variety of spruce peculiar to its climatic conditions. In the gathering of white spruce seeds the stations are fortunate in having acclimatized trees from which to collect seed. Seedlings produced from the native trees are always dependable. White spruce is subject to attacks of spruce sawfly, but this pest can be controlled very easily, as noted above.

Jackpine *(Pinus Banksiana)* is native. Although this pine grows well naturally in many parts of the prairie country, it does not thrive on level land showing slight traces of alkali. It is almost a complete failure at Sutherland.

Lodgepole pine *(Pinus murrayana)* is another native Western Canadian tree which grows well in its wild state, but at Sutherland it is most unthrifty in

growth wherever traces of alkali are found in the soil. It is relatively free from insect injury and disease.

Colorado blue spruce *(Picea parryana)* such as *Picea pungens* and Koster, grows well and no tree has ever been lost from climatic conditions. A few blue spruces have been lost through injury by rabbits.

Deciduous Trees for Prairie Planting

Among the broadleaf trees the best and most lasting are ash, elm and caragana. These are the trees that grow best during long periods of drought. Poplars and willows should be planted sparingly as neither can well withstand long periods of drought, unless in addition to the annual rainfall the roots find access to table water in the soil. Where water in the soil is always available, poplars and willows will live for many years. Manitoba maple *(Acer negundo)*, which is probably one of the best shade-producing trees, also does best when the roots find access to table water.

Cotoneaster, *Caragana pygmaea*, *Spiraea oblongifolia*, *Spiraea sorbifolia*, lilacs, Tartarian honeysuckle, Tartarian maple, Ginnalian maple, Russian almond and many other kinds of shrubs and vines thrive beautifully.

EXPERIMENTAL STATION, ROSTHERN, SASK.

The purchase in 1908 of a quarter-section of land at Rosthern, midway between Saskatoon and Prince Albert, marks the beginning of the experimental station for central Saskatchewan. Three additional quarter-sections bought in 1913 built up the station to its present area of 649 acres.

The soil surrounding Rosthern is, generally speaking, a light sandy loam on which a good type of mixed farming, with some specialization in dairying and hog raising, has been developed.

The land on which the station was organized had been farmed for many years and was badly infested with weeds. It was fenced and cleaned, a full complement of good buildings was erected, windbreaks and ornamentals were planted, and a number of experimental projects designed to cope with the agricultural problems peculiar to the north-central section of Saskatchewan were laid down. Today, spacious lawns and ornamental grounds offer excellent facilities for the station to play the part of host at picnics and field days of every description. The agricultural field day held co-operatively each year with the Wheat Pool alone attracts several thousand farmers with their families.

Fruit Testing a Major Project

Fruit testing at Rosthern has developed from the small beginning in 1911 until more than 20 acres are now devoted to it. Numerous seedlings, mainly from the Morden experimental station, are being fruited in the hope of obtaining better and hardier varieties than those recommended at present. Osman, Mecca, Olga, Amur, and Garnet crab apples, Assiniboine and Mammoth plums, and Champa and Sioux cherries have proved perfectly hardy, and of good size and quality. The Rosthern seedling apples, Calros, Anaros, and Jacques, show great promise in hardiness, quality, and productiveness.

Comparative tests conducted with small fruits and vegetables have yielded a reliable list of varieties and cultural practices recommended for northern Saskatchewan.

A very select herd of Holstein cattle has been developed chiefly from two pure-bred heifer calves purchased in 1914. The high quality of the herd sires has had a strong influence in stamping uniformity of type and conformation. The present policy is to concentrate more or less on line breeding in order to intensify the blood of several closely related proved sires whose progeny have outstanding records to their credit.

The highest-producing cow developed so far was R.E.S. Madrigal Gypsy Keyes, which produced in one lactation period over 20,000 pounds of milk with a 4·23 per cent butterfat test. The herd is now on twice-a-day milking, and on this basis the two-, three- and four-year-old cows have as a group consistently higher production and butterfat records than their dams.

The last experimental feeding test with beef cattle proved that for finishing yearling steers, coarsely ground wheat when fed in conjunction with cut oat sheaves compared very favourably with barley chop.

In 1930 a flock of pure-bred Shropshire sheep was established on a foundation possessing a high percentage of imported blood.

Some Outstanding Records with Swine

More than 30 Yorkshire sows have qualified in Advanced Registry, with very creditable scores on prolificacy, maturity index, and carcass test. Rosthern King Cid 25, the only pure-bred Yorkshire boar bred at the station to be exhibited at a fair, won the coveted Grand Championship honours two years in succession at the Royal Winter Fair, Toronto, his progeny also capturing numerous awards. A year later this boar sold for the highest price on record for a Yorkshire boar in Canada.

Experimental hedges and ornamental grounds at the Rosthern experimental station.

Three Barred Plymouth Rock pullets completed their yearly record in 1935 with more than 300 eggs, and the entire flock would average well over 200 eggs per bird.

Most of the experimentation conducted in field husbandry has been with rotations. A five-year rotation of summer-fallow, wheat seeded down, sweet-clover hay, wheat, and oats shows promise of fitting well in a mixed-farming program. To assist in controlling weeds, all manure is rotted before application, all feed is crushed before being fed, and only clean seed is sown. Employing a duckfoot cultivator on summer-fallow land directly ahead of the drill and leaving the soil in a cloddy instead of a pulverized condition have proved remarkably successful in controlling soil drifting, which though often prevalent on neighbouring farms is almost unknown on the station.

Cereal work is restricted to the growing of farmers' samples of grain for purity determination, the growing of the principal recommended varieties of wheat, oats and barley, and the production of seed grain suitable for the territory served by this station.

EXPERIMENTAL STATION, SCOTT, SASK.

Since 1911, when experimental work was begun there, the station at Scott, Sask., has determined facts on the climate, soil, and production of the dry, windswept plains of northwestern Saskatchewan.

Average annual precipitation for 24 years has been 13·39 inches, but only half the moisture is received during the summer months, June giving more than twice as much as April and May combined. The average frost-free period is 86 days and freeze-up may be expected early in November. Sunshine averages 2,166·5 hours per year; wind, over 100,000 miles annually, with severe winds occurring during April and May.

This type of climate means that grain production is the main source of revenue and that the dominant considerations are early maturity, drought resistance, hardiness, and tillage in relation to soil-drifting control. Usually, seeding is in progress by the first of May and wheat harvest commences the third week of August. Crop yields show considerable variation and low yields are not uncommon.

At the Scott station, important results have been obtained from the use of fertilizers on grain crops. Note the earlier and more even heading of wheat on the left, following the use of phosphatic fertilizer.

For many years Marquis was the leading wheat variety, but on account of higher yields and earlier maturity Garnet gained popularity from 1927. No oat has excelled Banner or Victory, but Gopher leads among early varieties. Barley is not profitable and in the drier area served, is scarcely grown. Flax has not produced highly enough to make its returns equal to wheat.

Forage Crops Present a Difficult Problem

Forage crops have limitations because of drought and severe winters. Oats grown as an annual hay excel all other forage crops combined. Grasses for hay are limited to western rye, brome and crested wheat, but their yield is less than half that produced by oats. Sweet clover excels alfalfa in yield and in ease with which stands may be obtained. Dependable stands of hay cannot be obtained

by seeding with grain, but they can be improved by cross seeding, and by shallow seeding on firm soil. Seeding without a nurse crop gives excellent stands and greatly increased yields. For silage, sunflowers more than double the yield of corn. Soybeans are invariably a failure. Among the root crops turnips do best but their yield is usually insufficient to make them widely grown. Work on forage is concentrated on pasture improvement and utilization of crested wheat grass for restoration of soil fibre.

All forms of crop rotations demand summer-fallowing and, generally speaking, the more frequently it occurs the greater the yields and the more profitable the rotation. Early working, shallow tillage and weed destruction are called for in summer-fallow practice. There is no essential difference in yield of wheat after ploughed and ploughless fallow. Spring treatment of summer-fallow before seeding demands early tillage which leaves a rough structural surface to prevent soil drifting. Soil packing has not increased grain yields. Ploughing and other tillage has been best when done as shallowly as possible consistent with effective work. When grain is seeded on stubble some form of tillage is necessary, spring work being preferred and ploughing being best for loam soils. Barnyard manure and phosphate fertilizers have increased yields over a period of years by approximately six bushels per acre.

Breeding Stock from Station Herds Meets Brisk Demand

Foundation stock of pure-bred Shorthorns was obtained in 1921. In 1930 the average annual milk production was 5,384 pounds, a figure that had been raised to 6,237 pounds, with an average fat test of 4·2 per cent, by 1935. The demand for breeding stock from the Shorthorn herd at Scott always exceeds the supply. For 13 winter seasons steer feeding was conducted to make available information on the value of silage, different roughages, single grains and grain mixtures.

A flock of range ewes with no particular breeding was purchased in 1917 and the value of pure-bred sires was demonstrated. A comparison of Shropshires, Cheviots and Rambouillets was decided upon in 1935.

Yorkshire pigs have displaced the Berkshires because of their superiority for the export trade.

From a beginning with several breeds of poultry, a flock consisting exclusively of Barred Plymouth Rocks, with an average yearly production of slightly more than 200 eggs, has been built up. Contrary to the general opinion, it has been demonstrated that turkeys can be successfully raised in yards when out of contact with other poultry. Demand for breeding stock and information on poultry continues to increase.

In a quarter of a century the raw prairie used for horticultural grounds has been transformed into an ornamental site of surprising beauty. More than 200 specimens of trees and shrubs are found in the arboretum, but the dry climate demands, for good satisfaction, approximately 150 square feet of bare soil for a tree and 35 square feet for a shrub. While tree fruits have limitations, more than 350 varieties are under test and recommended lists are revised as information is established. Comprehensive tests of vegetables and flowers have enabled the listing of adapted varieties for guidance of the producer. Small fruits can be grown with reasonable success. Horticultural work is receiving greater recognition and requests for information on this subject are continually increasing.

EXPERIMENTAL STATION, MELFORT, SASK.

One of the younger units of the Experimental Farms System is the station at Melfort, designed to serve the farming community of a large, unique soil-belt in northeastern Saskatchewan.

Organization of this station began in the autumn of 1934 on one section (640 acres) of land situated three miles south of the town of Melfort in the

heart of the Carrot river valley, an area not severely affected by drought and famous throughout Western Canada for its rich, dark-loam soil. Coarse grains grow particularly well; consequently the raising of live stock, especially hogs, is an important part of farming operations in the district.

The work so far has, of course, been mainly that of organization. During the autumn of 1934, rapid progress was made in erecting buildings. This work was resumed in the spring of 1935 and carried on throughout the summer. Machinery was installed in the elevator to clean grain grown on the station as well as to do custom work. During the spring of 1936, 2,500 bushels of seed grain were cleaned for farmers in the locality. All the buildings are lighted by electricity and the grain cleaning machinery is operated by electric power.

An outstanding herd of registered Shorthorn cattle was placed on the farm in the autumn of 1934. The herd now comprises 38 head. While the animals are of straight beef breeding a fair percentage of the cows are passably good milkers. As far as practicable the cows and heifers are entered in R.O.P.

Testing the Landrace Hog under Prairie Conditions

A small herd of Swedish Landrace pigs was placed on the farm in 1935. Careful records are kept of their prolificacy, feeding ability and carcass quality, in order that accurate comparisons may be made between this breed and Yorkshires on other government farms.

Experimental work with field and forage crops and with cereals is under way, but time is needed for data to accumulate.

More than 12,000 trees and shrubs were planted during 1936 to provide shelter and to beautify the station site.

EXPERIMENTAL STATION, SWIFT CURRENT, SASK.

The Dominion experimental station at Swift Current, Sask., was established in 1920 on the recommendation of a commission appointed to investigate the problems relating to drought in southwestern Saskatchewan. Located in the midst of the short-grass prairie zone where low precipitation is accompanied by a high rate of evaporation, the station is well situated to study the problems of dry-land farming.

The 1,800 acres of land operated contain three general soil types: light loam, loam, and heavy, poorly drained soil, and represent the major soils series found in southwestern Saskatchewan; namely, the Cypress and Haverhill series. Nearly all the soils are low in organic matter but high in fertility and produce excellent yields when sufficient moisture is available.

Several important problems closely associated with the predominant condition of restricted rainfall are receiving attention in the experimental work of this station. These are soil drifting, weed control in relation to conservation of moisture, and the efficient application of labour and machinery in the farm program.

Soil-drifting experiments are being conducted to determine the best methods of control by strip farming or the use of cover crops and trash covers.

Control of Soil Drifting Hampers Weed Control

When soil-drifting control is essential weed control becomes particularly difficult. Good judgment is required in striking a proper balance to avoid the overcultivation that encourages soil drifting. The type of machinery used for cultivation is important; the machines being tested at Swift Current are applicable to most farms in Western Canada.

The control of weeds is distinctly influenced by the rates and dates at which crops are seeded. Preseeding cultivation, delayed sufficiently to allow weeds to

grow, followed by seeding at heavier than customary rates, gives the most satisfactory control. The rates of seeding which give the best results are: wheat $1\frac{1}{4}$ to $1\frac{1}{2}$ bushels; oats 2 to $2\frac{1}{2}$ bushels; and barley about 2 bushels per acre.

Soil-moisture investigations have occupied a very important place in the program of the station since 1921. They have included meteorological studies, examination of soils, studies on the use of water in the production of crops under various conditions, the value of summer-fallow in conserving soil moisture, the loss of moisture through weed growth, and the drought resistance of various crops.

What Soil Moisture Studies Reveal

Some of the more important findings may be listed briefly as follows:—

Wheat on summer-fallow requires from 30 to 59 tons of water to produce one bushel of grain. This amount includes the water actually used by the plant plus water lost by evaporation.

More water is required per unit of dry matter in years of subnormal rainfall than in years of normal or high precipitation.

Crops always used all available moisture by harvest time; frequently the available moisture was used up early in the season, with resultant plant injury.

Weed growth materially reduces soil moisture and must be controlled if summer-fallow is to be effective. The control of weed growth after harvest is particularly important since as much as 50 per cent of the total stored moisture may be accumulated from post-harvest rains. Control of weed growth either by ploughing or surface cultivation should be begun early in the season.

Methods of summer-fallowing that completely prevent weed growth and loss from run-off may store 21 to 42 per cent of the precipitation in the soil.

Extensive farm-machinery investigations dealing with most types of farm equipment have enabled the station to make valuable contributions to the improvement of western agriculture. Experiments with stubble burners, begun in 1923, resulted in the very profitable discovery that expensive machines were no more effective than the drag harrows in burning stubble.

With tractors, the comparative merits of track and steel-wheel equipment were investigated first; then in 1933 tests were begun with pneumatic rubber tires. When compared with steel wheels, rubber tires give more satisfactory traction under adverse conditions, reduced repair costs, greater comfort and ease of operation, less dust in the air cleaner, and reduced vibration in the machinery. An average saving in fuel of 24·36 per cent was found when working with a one-way disk.

Pioneer Work with the Combine Harvester

The station played an important part in the early history of the combine reaper harvester in Western Canada by conducting in 1922 one of the first tests in Canada with this type of machine. A season's work demonstrated clearly the saving involved in harvesting by the combine method, but the dangers arising out of delayed cuttings, such as loss from shattering, hail, weathering, snow, etc., caused some hesitancy in accepting the new development. As further tests in subsequent years and under different seasonal and crop conditions showed that these dangers were important, the swather and pick-up attachments to use with the combine reaper thresher, and the header barge were introduced. These supplementary machines are still being investigated, as are other harvesting and threshing methods.

The designing, at Swift Current, of machines to facilitate the operations of seeding, harvesting and threshing on experimental cereal plots has permitted

this work to be expanded considerably throughout the Experimental Farms System.

Investigations with cereal varieties, while directed toward the development of superior varieties for this territory, have also shown the relative worth of existing varieties. The outstanding cereal variety developed at Swift Current is the smooth-awned barley, Sans Barbs Early.

The Swift Current station has devoted considerable study to the problem of suitable farm machinery. This photo shows the first combine harvester used in Canada, introduced by the Swift Current station in 1922.

Experiments have shown that the best catches of perennial and biennial forage crops are to be obtained by late fall or early spring seedings. Legumes and grasses have been seeded successfully on stubble and weedy land by this method. When a good stand is obtained the sod should be left down as long as satisfactory yields are produced.

EXPERIMENTAL STATION, LETHBRIDGE, ALTA.

The beginning of the century was marked in southern Alberta by a rapid influx of settlers to the newly opened irrigable lands and also by the progress that extensive dry-land wheat farming was making with the production of both spring and winter wheat. These developments in a new, untested and unknown territory brought a variety of agricultural problems for which solutions had to be speedily found and passed on to the new settlers.

In 1906 the Lethbridge experimental station was organized to do this work. Irrigation was not practised elsewhere on the Canadian prairies and the problems involved could not be solved with information from abroad; moreover, the problems of the dry-land farmer located in the Chinook belt, with its persistent winds and peculiar climatic conditions, were unlike those found in any other part of Canada. Because of these conditions and the need for experimentation in

both lines of agriculture, a site was chosen half of which was irrigable and half non-irrigable or dry-land. As each type of farming has a definite place in the agricultural development of the country the object has never been to compare the relative merits of the two systems but rather to solve the problems peculiar to each.

Live Stock Important Despite Reduction in Range Lands

A gradual reduction in range lands took place with the increase in grain farming, but live stock continued important in southern Alberta. A supplemental relationship has naturally developed between the range areas and the irrigated areas where feed can be successfully grown. To encourage this development, early live stock experiments took the form of winter feeding of range cattle and sheep for finishing. A complete report of the lamb-feeding trials was published in 1936.

The superintendent's residence at the Lethbridge station in 1908 and the same house in 1936 showing the transformation from the bald prairie.

In the early years information was obtained on methods of breaking sod, rates and dates of seeding, suitable varieties and rotations and other factors incident to the development of a new country. Testing of various crops has been continued as new varieties have been developed, but the original problems have been solved and superseded by equally important problems in cultural methods for soil-drift and weed control.

Because of the climatic conditions and the Chinook winds characteristic of the southern area served by the station, soil drifting for a while threatened to eliminate the use of summer-fallow and thereby to prohibit dry-land farming. The dissemination of information gathered in studies of this problem has been one of the station's most important contributions to Canadian prairie agriculture during recent years. The main drift-control practices now recommended are strip farming, ploughless fallowing with special attention to maintaining trash covers, preserving lumpy structure on ploughed fields, modified listing, scattering straw or manure, and seeding cover crops in late summer when moisture conditions will permit the practice.

Water Control on Irrigated Farm Lands

The optimum use of water has been a major problem in irrigation projects. Experiments have shown definitely at what stage of development various plants should be irrigated, how irrigation influences the yield and quality of crops, and what effect it has on the soil. As soil fertility may readily become a limiting factor in irrigation farming, it has been given much attention. Definite information has been obtained regarding the use of commercial fertilizers, barnyard manure and green manure in the production of various crops.

A number of rotations have been tested to determine those most suitable for an irrigated farm. Alfalfa has been incorporated in the long-time rotations to build up the nitrogen supply, though it is a heavy phosphate feeder and gradually depletes the available phosphates in the soil. Nevertheless it is admirably suited to irrigation agriculture. In short-time rotations, sweet clover has largely displaced alfalfa and is used both as a feed and a green-manure crop.

Permanent irrigated pastures, under test for 22 years, have demonstrated suitable mixtures as well as management practices which will give optimum results under irrigation. Kentucky blue grass and white Dutch clover are the most persistent species and usually supersede all others in an old pasture regardless of their proportions in the original mixture. Carrying capacities have been brought to a high level and the pastures yield cheap summer feed of high quality.

Irrigation agriculture and live stock production are practically inseparable if the former is to be successful. One of the chief live stock projects has been the development of an improved range sheep. Progress must be slow, but gratifying results have been obtained from the use of the Corriedale crossed with the Rambouillet, the progeny later being selected and inbred. Dairy cattle, poultry and swine were later added to the experimental material and horse breeding has been a major project since 1934.

Horticulture Thrives Under Irrigation

On the irrigated part of the station, horticulture is an important field for experimentation. As early as 1908 apple trees, plums and a variety of bush fruits were set out; vegetables, too, have been tested. Varieties suitable for the district have been selected so that now limited fruit and vegetables growing for the farm home and the local market is an accepted fact.

Production of alfalfa and sweet clover in large amounts has provided an opening for beekeeping, an industry which has grown rapidly during recent years. The station has led the way in this development by obtaining information regarding management methods for summer and winter.

EXPERIMENTAL STATION, LACOMBE, ALTA.

As one drives through central Alberta and sees the beautiful farm homes, the well-painted farm buildings and the broad fields, it is difficult to believe that the last buffalo hunt and Indian uprising occurred within the past 50 years. But

during that half century the agriculture of central Alberta has passed from the ranching stage to a highly diversified type of farming. And the Lacombe experimental station has played an important role in the transition, for nearly every cultural practice in general use on the farms throughout the district had its origin, either directly or indirectly, at the station.

Established in March, 1907, the station serves an area extending from Calgary on the south to the Athabasca river on the north and from the Rocky mountains on the west to the Saskatchewan boundary on the east. The district can be divided into three major zones: the foothill and timber belt, the park belt, and the prairie.

Experimental work with cereals has developed to the point where records are kept on several thousand plots connected with variety testing, plant breeding to develop improved varieties, purity verification tests with farmers' samples and the production of pure seed. Certified and Elite seed of wheat, oats, barley, peas and flax are distributed.

Winter-Hardy Forage Crops Required

The first step in the forage-crop program was to find grasses and legumes with sufficient hardiness to stand the low winter temperatures which occasionally occur. It is now possible to provide excellent pasture for summer and high-quality forage for winter use. Approximately 25 per cent of the farms in the district are now growing alfalfa.

The Lacombe station is particularly strong in live stock; it maintains a breeding stud of 30 pure-bred Clydesdale horses headed by the imported stallion Strathore James—26996—, whose services are available to breeders. Only 6 out of 52 foals have shown any sign of joint-ill in the nine years that potassium iodide has been fed to both mares and stallions. Except for the first winter, all colts are raised entirely outside. All the horses other than stallions, young colts and work horses are wintered in the bush and fed from a self-feeder.

Breeding work with cattle commenced in 1912 with pure-bred Aberdeen-Angus and Holsteins. In 1932 the Holstein herd was transferred to the Lethbridge experimental station, and the Aberdeen-Angus herd was sold to breeders. A foundation herd of pure-bred Shorthorns was established with cattle received from the Dominion experimental stations at Indian Head and Swift Current, Saskatchewan. The objects of the breeding operations are to establish a combination of true Shorthorn type and character with good production of milk and butterfat, to supply improved breeding stock to farmers, and to supply animals for breeding and feeding experiments. The herd is accredited as being free from tuberculosis. It is periodically blood-tested to determine its condition from the standpoint of infectious abortion, and to find out whether it is possible and practical to eradicate bovine infectious abortion and allied diseases by means of the agglutination and complement-fixation blood tests.

Swine Studies Lead in Live Stock Work

Work with swine is the most important line of experimental work with live stock. Hogs were first kept at the Lacombe station in 1912, when four Yorkshire sows were sent from Ottawa and one Berkshire sow was purchased locally. In 1917 Duroc-Jerseys were added. This herd was carried until the fall of 1924, by which time it had been demonstrated that the Yorkshires and Berkshires, in the order named, made cheaper gains, and, further, that the demand for Duroc-Jersey breeding stock had decreased to a point where it would not justify the maintenance of the herd for this purpose alone. The Duroc-Jersey herd was replaced in the fall of 1924 by a carefully selected herd of Tamworths. As the Berkshires lacked the length and quality of finish necessary to yield high-class Wiltshire sides and as there was almost no demand for breeding stock, this

once popular old breed was discarded in 1932. The Tamworths, a hardy, thrifty breed of pigs for summer feeding, do not produce nearly as large litters as the Yorkshires and tend to produce seedy bacon. For these two reasons and because the Tamworths are less suitable than Yorkshires for the production of export bacon, this breed is rapidly disappearing in Alberta and was discarded in 1934 at Lacombe.

Five pigs sired by the Swedish Yorkshire boar, Malte of Svalof, and chosen for the slaughter test in Advanced Registry work at Lacombe.

About 50 pure-bred Yorkshire brood sows are now maintained in the herd, as well as six Landrace females and a Landrace boar. No distribution of Landrace breeding stock will be made until such time as its merits have been demonstrated under Canadian conditions.

The feeding and slaughter tests under the Advanced Registry Policy for swine have proved to be among the best methods so far tried for very careful selection of breeding stock. Only one Berkshire sow of a large number tested and only nine Tamworths passed the very high standard required under the Advanced Registry tests, but thirty-four Yorkshire sows and six boars have qualified and received official Advanced Registry standing since the policy was placed upon an official basis under the administration of an officer of the Dominion Live Stock Branch in 1929.

More than 100 young boars and gilts are sold annually to farmers at reasonable prices.

White Wyandotte poultry is kept for experimental purposes, and breeding stock of good quality is distributed each year at reasonable prices.

Ornamental Plantings Given Attention

A great variety of hardy deciduous and evergreen trees, ornamental shrubs, perennial and annual flowers, tree and bush fruits, and vegetables can be grown to advantage in central Alberta. The station campus, landscaped with trees and shrubs and flower borders, is an excellent sample of the beautiful effect that can be obtained when such material is used. Thousands of visitors each season

use it as an object lesson in beautifying their home grounds, while the vegetable and fruit plantations show what is possible with those crops.

Encouraged by the apiary at the station, many Alberta farmers have now adopted beekeeping as a profitable sideline.

RANGE EXPERIMENT STATION, MANYBERRIES, ALTA.

Following a series of dry years and farm abandonment, when more than ten million acres of grazing land were seriously depleted, the problem of re-grassing land unfit for crop production became acute on the western ranges. The Experimental Farms System made a detailed survey of the short-grass-plains area for the purpose of planning specific work to meet the immediate problems.

Cattle at the watering dam on the range at Manyberries, Alta.

Rather than create a large investment in land, equipment and cattle to carry out the work, the Dominion Government decided to co-operate with a stockman of long experience in the cattle and sheep industry. In 1926 an agreement was entered into with Gilchrist Bros. of Manyberries, Alberta, in which 18,000 acres of grazing land were sub-leased for the purposes of a range experiment station, a co-operative arrangement that has been in effective operation ever since. The station works hand in hand with the stockmen. Once an experiment gives some definite results an effort is immediately made to find its practical application in co-operation with the stockmen.

Four hundred head of Hereford cattle are grazed in the different experiments.

Surveying the Native Pasture Species

A detailed botanical survey has been made of the native species of the short-grass-plains area. The important species of grass are highly nutritious; up to the leaf stage they analyse as high as 18 per cent crude protein, and contain sufficient phosphorus and calcium to meet the animal's requirements. As the plant becomes cured there is a gradual drop in the protein and phosphorous content.

In addition to detailed plant studies at the station, surveys have been made of other grazing areas in order to study soil types in relation to vegetational types. The information obtained is particularly useful in rating land according to its agricultural value.

Under dry-land conditions most forage crops are difficult to grow, but with the best cultural practices on summer-fallow, fair yields of crested wheat grass, sweet clover, fall rye and spring rye have been obtained. The last two are particularly adapted due to their early maturity and ability to take advantage of the early spring moisture.

The development of small irrigation schemes by damming up the spring flood-water or diverting the spring freshet over the land by dykes offers great possibilities in the grazing areas to ensure feed supplies. A field of crested wheat grass given one spring flooding yielded one and three-quarter tons of hay in 1936, compared to one-half ton per acre from non-irrigated land.

Regrassing Abandoned Acres

One of the first problems undertaken at Manyberries was to find ways of regrassing the several million acres of abandoned farm land in Alberta and Saskatchewan. The most successful results were obtained with crested wheat grass. By seeding it in the fall of the year or in the very early spring on weed-infested land, complete stands of grass were obtained in three years. As a result of the many investigations undertaken, basic information was available in planning the reclamation program which faced the different governments in 1934.

All ages of cattle on grass will gain in weight from 2 to $2\frac{1}{2}$ pounds per day up to the time of maturity of the native vegetation. From then on, with the decline in the nutritive value of the vegetation, there is a gradual decrease until from September 15 on there is almost no gain. This information indicates that cattle should be marketed much earlier than has been the usual practice. It has particular significance in view of the serious drought in 1936, when a surplus of cattle together with a shortage of grass created a national problem.

The grazing land taken over by the station had no natural water supply. Sloughs held water for two months only and wells were too expensive to drill. Since 1927 a policy of building stockwatering dams has been followed, and 16 earthen dams of different types and sizes have been constructed. The station has never been short of water, though there have been winters with little snowfall followed by very dry seasons. This work has formed a nucleus for considerable water development in the grazing areas and has been valuable in planning the water-conservation program now in operation in Western Canada.

Adequate Water Supply Promotes Economical Grazing

By the construction of stockwatering dams, the use of grazing land is improved 40 per cent. Cattle walking more than two miles to water will not put on normal gains in weight. Five years' results show that in the dry area from 50 to 60 acres are required to maintain a mature cow on grass throughout the year. Overgrazing has a serious effect on both the pasture and beef production: the pasture takes years to rejuvenate, fewer pounds of beef per unit area are produced, and the animals do not enter the winter in thrifty condition. This results in an increased winter feed cost and a serious impairment to the animal's growth. It also has a cumulative effect on the weaning weight of the calves. Cows on overgrazed pastures produced calves 55 pounds lighter in weight than calves produced on normally grazed pastures.

Results of feeding experiments for wintering cattle show that alfalfa, oat hay, sweet clover, bluejoint and crested wheat grass have practically the same feeding value and that each can be fed alone successfully. Calves have been wintered on straw and one-third of a pound of oilcake per day with good results. If there is a shortage of roughage because of drought, this ration forms an economical substitute.

EXPERIMENTAL STATION, WINDERMERE, B.C.

Experimental work in the upper Columbia valley of British Columbia was begun in 1910, but in 1923 the present site was selected and gradually developed until 1929, when work on the Invermere area was discontinued. The station, situated midway between Cranbrook on the south and Golden on the north, occupies 430 acres, approximately one-half under irrigation. The valley, roughly 190 miles long, lies between the Rocky mountains and the Selkirk range. From the alluvial, flat, bottom lands of the valley the country rises in a series of benches to the foothills and mountains. The soil at Windermere is a silt loam with a gravelly subsoil, fairly typical of most of the soil in the district.

The average annual precipitation as recorded for 22 years is 11·3 inches, with approximately 60 per cent of this during the growing season. Irrigation is therefore necessary; the water is carried in metal flumes from Windermere creek to the station and distributed through dirt ditches. The furrow system of irrigation is followed as the soil is too light and not level enough to stand flood irrigation.

Ayrshire cattle on fertilized and rotationally grazed pasture on the Windermere station.

The lowest winter temperature recorded is 43 degrees below zero, registered January 20, 1935, and the maximum temperature is 99 degrees, on July 28, 1934. Spring frosts are recorded up until early June, and early fall frosts may be expected around September 1. Chinook winds and winter thaws render tree fruits an unsafe commercial proposition, but sufficient planting of the hardier varieties for local consumption is desirable.

Almost all phases of experimental work have been undertaken at the station in the past, but at present the work has been curtailed and live stock, poultry, bees and forage crop work are the main lines of endeavour.

Experiments with Sheep, Cattle and Hogs

Experimental feeding and breeding work is conducted with Ayrshire cattle, Hampshire sheep and Yorkshire swine. The Ayrshire herd is headed by an outstanding sire of proved merit in Noble Betsy Wylie–104582–, sired by Hillside Jim's Peter Pan and whose dam, Betsy Wylie, has a record of 21,805 lb. milk,

1,103 lb. fat, with an average test of 5·06 per cent for the year. The herd received its accreditation certificate in 1925, was abortion-free in 1927, and has not had a reactor since the above dates.

The Hampshire flock is small but select. The Hampshire ewes are good mothers and the lambs deve op quickly. Average increase during the past seven years was 149 per cent. Fleeces average 9·5 lb. of good, medium-staple wool. The sheep population has increased during the past few years throughout the valley and is made up entirely of farm flocks. Range flocks, however, appear to have possibilities where provision can be made for winter feeding.

A small herd of Yorkshire swine is maintained to meet the demand for breeding stock throughout the district. With so little grain being produced under irrigation, the possibility of increasing hogs is rather doubtful, unless more advantage is taken of alfalfa pastures and the hogging-off of crops.

No artificial light or heat are used in the poultry house and even under the severe climate conditions the White Leghorn is proving very productive. For breeding purposes only those birds are used that have no body disqualifications and produce 200 eggs or more, of at least 24 ounces to the dozen.

From the small apiary of Italian bees the average production per colony over a 20-year period has been around 90 pounds per season. The Kootenay hive case has been used very satisfactorily for a number of years and little trouble has been experienced from winter losses.

Alfalfa is the premier forage crop of the district. It is much hardier than clover and does particularly well under irrigation. Two and three cuttings may be taken in a season but at the station two good cuttings are taken and the third growth is either ensiled or pastured.

As a cash crop potatoes or field peas are featured.

Irrigation, with the resultant distribution of weed seeds, particularly couch-grass seeds, presents a problem that so far has not been met satisfactorily.

New Pea Varieties Prove Their Merits

Although, as has been mentioned previously, tree fruits are not a commercial proposition, the hardier bush fruits do very well, but their season is late. Considerable work in breeding and selection of garden peas has resulted in the station bringing out several new varieties, the better known being Kootenay, Director and Bruce. It has also fostered the development of the Lincoln pea, and at the World's Grain Show at Regina the station took first prize for this variety in the canner class.

RANGE EXPERIMENTAL SUB-STATION, TRANQUILLE, B.C.

In 1931 range investigations of the Experimental Farms System were extended to British Columbia at the request of the British Columbia Department of Agriculture and the British Columbia Beef Breeders' Association.

Surveys indicated that the spring, fall and winter ranges consisting mostly of bunch grass *(Agropyron tenerum)* had become seriously depleted. The extended use of the undergrazed summer ranges in order to alleviate the situation at other seasons would tend to shorten the grazing periods on the depleted areas. The use of summer ranges in relation to winter management was also a problem, and the outline of experiments in this report indicates the major work undertaken to meet it.

In accord with the recommendation of a Dominion-Provincial committee, an agreement was drawn up in 1934 between the Dominion Experimental Farms and the Tranquille Sanatorium which was operating a herd of 800 cattle and a large area of grazing land typical of most of the range lands in the interior of British Columbia. The Experimental Farms were to have full control of the management of the cattle during the summer grazing period for experimental

work, and the Sanatorium was to bear the expenditures for the normal operation of the ranch. Preliminary experimental work was initiated in 1934.

The investigations under way are divided into the following divisions:—

Plant Studies.—*(a)* To collect, identify and determine the nature of the vegetative types in British Columbia; *(b)* To study growth development, nutritive value and palatability of the principal range plants in British Columbia; *(c)* To collect and identify principal range plants that are poisonous to live stock and to study control measures of the same; and *(d)* To study plant succession on various types of range land.

Range Management Studies.—*(a)* The segregation of cattle in obtaining efficient range use and extending the time of use of the summer ranges in order to follow improved conservation practices with the spring-fall range; *(b)* The use of salt in range management; *(c)* The development of watering places; *(d)* The activities of cattle on the range; *(e)* The response cattle make to different grazing practices by seasonal gain in weight and comparative gains of different ages; *(f)* The improvement of the calf crop by proper distribution of bulls, range management plans, and the use of breeding pastures; and *(g)* To conduct ranch organization studies.

Special Studies.—A special study is being made of certain plant species which are of importance to British Columbia. Chief among these are the pine grass *(Calamagrostis* spp.*)*, annual brome grass *(Bromus tectorum)*, and timber milk vetch *(Astragalus campestris)*.

EXPERIMENTAL FARM, AGASSIZ, B.C.

The Agassiz experimental farm, picturesquely situated on about 1,400 acres in the lower Fraser valley 70 miles east of Vancouver was purchased in 1888 and occupied the following year. Only 300 acres of the property are suitable for cultivation; the remainder is mountain or bench land, and although at one time some orchard crops were grown thereon, the idea of cropping it was later abandoned. It is now used only for the fuel it produces and as a source of water supply. A concrete tank 300 feet up the mountain side is filled from a small stream and provides a wonderful gravity water system for domestic purposes.

Although work along the main lines of agriculture has been carried on since the establishment of the farm, the major feature up to 1911 was horticulture; since then dairy farming has been emphasized. Many side lines have, however, been studied, especially during the past 20 years, until live stock, poultry, field crops, horticulture, and bees now receive considerable attention.

Holstein Herd Highly Rated

Breeding and experimental work with dairy cattle was launched in December, 1911, by the purchase of a carload of grade Holstein females and a pure-bred bull. An effort made to build up a grade herd of high-producing cows by the use of pure-bred sires increased milk production 29·72 per cent and butterfat production 25·09 per cent. At the annual meeting of the Canadian Holstein-Friesian Association in 1930 the Agassiz experimental farm was presented with a Master Breeder's Shield, the first in Canada for a medium-sized herd. The herd has been tested regularly for tuberculosis and contagious abortion.

Previous to 1917 horses were maintained solely for working purposes. At that time an imported Clydesdale mare was purchased and four more young mares were added later. The 20 pure-bred horses now on hand have been bred on the farm, except three foundation mares and the stallion. Some horses have been shown at Class A fairs and amongst the large number of prizes won are

eight championships, taken during the period 1922-35, at the Portland, U.S.A., New Westminster, and Vancouver Fairs.

For more than 20 years a fair-sized flock of Dorset Horn sheep has been maintained at Agassiz. The ewe flock is a particularly good one, the animals being of excellent type and very prolific. A specialty is made of raising lambs out of season for the Easter market.

A service offered to the swine industry of British Columbia by the Agassiz farm is the supplying of good boars, especially to outlying districts, at reasonable prices. British Columbia imports immense quantities of pork and pork products annually, and anything done to encourage hog raising is creditable work. The Yorkshire is the breed maintained and the quality of the stock has always been good. Three of the first four sows to qualify when the Advanced Registry Policy for swine was inaugurated were bred at Agassiz, and Springdale Major 10, the farm's senior sire, was the first boar to qualify.

High Marks in Poultry Production

The poultry department originally maintained no fewer than six breeds; now only Barred Plymouth Rocks are kept. The Agassiz laying contest, probably more than any other single factor, has done much to advertise British Columbian and Canadian poultry to the world. In 1926 a pen of ten birds made a then world's record of 2,946 eggs in a year. A Barred Plymouth Rock bred by this farm produced 326 eggs at that time, and a White Leghorn made another world's record of 351 eggs in the year. Four years later another White Leghorn, No-Drone 5H, produced 357 eggs in a year, averaging in weight 26 ounces to the dozen. In 1933 Dereen 10L made a desperate effort to beat No-Drone's egg production—but was able only to equal it. Moving pictures of this bird were shown in a news reel in many of the larger cities on this continent.

Derreen 10. L., bred at the Agassiz experimental farm. In 1933 she made a record of 357 eggs in 365 days.

A four-year rotation of hoed crop, grain seeded down, hay, pasture has proved to be of special merit and is well adapted for conditions as they exist. In earlier years the forage crop experiments consisted largely of variety testing of such crops as mangels, carrots, turnips and ensilage corn. At present considerable effort is being concentrated on a study of perennial and biennial grasses and legumes for hay and pasture purposes. Fibre flax has been grown successfully for many years. The fibre has been reported to be of exceptionally good spinning quality and similar to the best grade of Irish.

The history of horticulture at the Agassiz experimental farm may be divided into three periods. From 1888 to 1911 was a pioneer period during which large numbers of plants of different kinds were planted out and tested for their suitability. The only living monument to this first horticulture is the beautiful collection of ornamental trees and shrubs. From 1911 to 1925 was a period of lessened activity concerned mainly with variety and small cultural experiments with vegetables and bush fruits. From 1925 dates a period of expansion inaugurating the study of more complex experiments, using modern methods of field plot technique, utilizing the facilities of laboratories and publishing scientific and popular articles based on the results obtained from field plot experiments.

Beekeeping Given Encouragement

Bees have been kept at Agassiz continuously from 1896. Little attention was given to them during the early years, and up to 1912 they were kept in home-made hives. In 1921, with the assistance of the Provincial Apiarist, practical demonstrations of handling bees were made for the benefit of beekeepers, and small experiments were undertaken. It was, however, soon apparent that for accurate experimental results larger groups of colonies for individual trials were necessary. Accordingly, during the years of 1927 and 1928 the apiary was increased to 60 colonies and moved to a new location with an apiarist in charge. New experiments were planned using larger numbers of hives, and more reliable results were thus assured.

EXPERIMENTAL STATION, SUMMERLAND, B.C.

The Summerland experimental station in the Okanagan valley of British Columbia was established in 1914. Since that time it has developed rapidly in its work of helping growers of the Okanagan valley and adjacent areas with those problems which they are unable to solve for themselves. The facilities of the station have also been used by the National Research Council in the investigation of damage caused by smelter smoke.

Fruit growing, of prime importance in the Okanagan, naturally has claimed most attention, and good progress has been made towards the solution of problems in soil fertility, cultural methods, irrigation practice, varieties, pruning and thinning. It is now known, for instance, that humus, nitrogen and boron are the elements of soil fertility in which Okanagan soils are most likely to be deficient, and that unduly large applications of nitrogen are likely to result in poor-quality fruit.

The Search for Improved Varieties

From the beginning the need for improved varieties has been apparent. Hardy, early-maturing peaches were required. This need was met by the introduction of Vedette, Valiant and Veteran, three varieties originated by the Vineland (Ontario) experiment station. There is still room, however, for an attractive new winter apple combining the quality and hardiness of the McIntosh, the vigour and heavy-yielding capacity of the Delicious, and the long storage life of the Newtown. In the search for something to fill these requirements, over a thousand seedling apples have been brought to bearing age. These are the result

of hand-pollenized crosses of such varieties as McIntosh, Delicious, Newtown and Winesap. Storage tests have revealed that several of the new seedlings have commercial promise.

The problem of hardy rootstocks has received special attention. In the station orchards there are now more than 1,500 apple trees worked on root systems of known origin. This long-time project is expected to provide valuable information on the most economical methods of propagating hardy, vigorous, disease-resistant trees which can be relied upon to produce heavy yields of high-quality fruit over a long period of time.

A young prune orchard and alfalfa field grown under irrigation at the Summerland station.

During recent years the rapidly increasing tonnage of fruit produced in the Okanagan valley has focused attention upon marketing problems. Experiments have shown that breakdown of the Jonathan apple can be prevented by picking the fruit at the right time. The storage requirements of various fruits have been determined. For instance, it is now known that the storage life of pears can be prolonged materially by reducing them to a temperature of 32°F. immediately after they are picked. It is also known that pears do not ripen properly at low temperatures, but must be removed from cold storage and ripened at temperatures between 60 and 70°F. in order to develop full quality. Again, it is now general knowledge that prompt storage at 32° is necessary to ensure long storage life in the McIntosh and Delicious apples, whereas Grimes Golden should not be stored at temperatures below 40°F.

Cold Storage and Fruit Products Research

Development of cold-storage facilities in the Okanagan valley made it possible to market much larger quantities of fruit than would otherwise have been possible. Nevertheless, difficulty was still experienced in finding a profitable market for low grades and undesirable varieties. To ascertain means of utilizing these, a fruit-products laboratory was established. Already a satis-

factory outlet for Royal Anne cherries has been developed. Experiments have revealed methods of improving the quality of dehydrated apples, and investigations in progress with canned apple juice, apple cider vinegar, apple chips, and apple syrup indicate that these products promise to provide remunerative outlets for low-grade apples.

While the activities of the Summerland station are directed mainly toward the solution of problems encountered in the fruit industry, attention is also devoted to vegetable problems. Investigations have revealed that cantaloupes grow best when supplied with comparatively small amounts of irrigation water, and that the tomato has quite exacting nutritional requirements. Proper balance between nitrogen and potash is necessary to secure the most satisfactory results.

Tobacco investigations were conducted during an eight-year period. From the results of these investigations, reliable information is available concerning the varieties and cultural practices which are necessary to produce marketable tobacco in various parts of British Columbia.

Aiding the Dairy Industry

The Okanagan dairy industry is of greater importance than many people realize. There are more than eight thousand dairy cattle in the Okanagan valley and adjacent territory. The seven creameries have an annual output of over 1,500,000 pounds of butter. The Jersey herd at Summerland contains some outstanding animals, and provides a source of healthy, high-quality breeding stock for Okanagan dairymen.

Similarly the flock of White Wyandotte poultry which combines high egg production, heavy body weight, large egg size, good breed characteristics and low mortality, now serves as a reliable source of superior breeding stock.

The Summerland experimental station is primarily an investigational institution, but it is frequently called upon to perform work of an educational nature. Members of the staff deal with many enquiries, give radio talks, prepare popular and technical articles, and address public meetings in carrying out this important part of the station's program.

EXPERIMENTAL STATION, SAANICHTON, B C.

The experimental station for Vancouver Island, located at Saanichton, was not in condition to be planted for several years after the land was taken over in 1912; for the property was in heavy timber and clearing land in the Coast region of British Columbia requires patience, time and considerable money. Trees six feet in diameter may have almost as much wood below the surface as above it, and even when they are removed and the ground is levelled for the plough, a considerable portion must be tile-drained. Bringing land under cultivation on Vancouver Island is, therefore, often too costly.

Excepting the park area, the station land is now all cultivated. The soil, though typical of the district, deserves careful attention, not only because of the difficulty met with in working it, but especially in the conducting of experimental work. Nitrates made available by constant cultivation during the summer are washed out during the excessive rainfall of the winter months unless great care is exercised in providing cover crops to take up the available plant food during autumn and winter. Experimental work in laboratory and field shows a deficiency in phosphorus and an acid condition on all the fruit lands. Sharp change on a given area makes it difficult to conduct consistently accurate experimental work, for the soil alters from peat to sand, to clay, to gravel in rapid succession, probably as a result of glacial deposition.

In a district where the great majority of the farming folk occupy small holdings, the most intensive type of work is often attempted with the hope of obtaining the largest possible return from the small acreage cropped. This has

Scenes which indicate some of the activities at the experimental station, Saanichton, B.C.

resulted in great extension of the small-fruit industry, greenhouse and garden work.

Fruit Growing Experiments

The Vancouver Island station has devoted much time to apples, pears, plums, cherries, medlars, and other tree fruits. Though fair apples are often produced on the Island, the district is only moderately well suited to this fruit. One of the chief reasons for this is that the ground is rarely frozen. Pears, though, always do well. The right varieties are in demand and sell at remunerative prices. Some varieties of cherries compete fairly well with cherries coming from the South. Peaches are almost a failure when grown in the open, and apricots wholly so; but on the walls of buildings these two stone fruits occasionally give a very good account of themselves. Plums, though not annual bearers, produce well enough, but the finest Californian sorts are not very successful. The need for water during the dry summers is acute. The highest returns from the land will never be realized until some form of irrigation is provided.

The experimental work has included studies in pollination, pruning, spraying, fertilizing, until a fairly successful mode of procedure has been evolved. New problems continually present themselves and are being attacked scientifically.

Much attention is being given to the culture of strawberries and loganberries. As the strawberry usually matures before the advent of the driest weather excellent crops are often secured, frequently in advance of the crop grown in other sections. The strawberries are accordingly shipped far afield. During the past few years large areas have been set to logans, which are dried, canned, frozen and preserved in many ways to meet the demand for them.

Very definite attention has been given recently to the production of Elite stock vegetable seed. This has frequently become the foundation-stock seed for the variety in Canada. Mulch-paper experiments have demonstrated clearly the value of the paper for the heat-loving plants. As the nights are cool the paper enables certain plants to flourish which otherwise could not be grown.

Ornamentals include subtropical species not found in other parts of Canada. The value of bulbs grown on the station farm has been demonstrated throughout the Dominion.

The possibilities of apiculture are receiving close attention. The Island is being mapped from the beekeeper's standpoint as rapidly as time will permit, and the various systems of wintering, swarm control, etc., are under test.

Profits from Poultry

Next to horticulture, poultry is the main interest of farmers on Vancouver Island. The most popular breed is the White Leghorn, but the Rhode Island Red has been gaining ground recently. The egg-laying contest for Vancouver Island has been conducted at the station. During the contest concluded October 1935, a Rhode Island Red pullet owned by J. Burgess, Qualicum Beach, V.I., B.C., laid 327 eggs in 51 weeks—a record for Rhode Island Reds in Canada. The previous year the Saanichton contest included the highest-producing pen in all Canada, the highest-producing bird for eggs, and the best bird for points, as reported in any egg-laying contest in Canada.

Much attention has been given to fall seeding of cereals that are usually spring-sown. If the fall-sown grain is hardy enough to withstand the mild winters it makes the best use possible of the moisture always present during the winter and ripens its crop the next year during the driest time. Most of the wheats are hardy; some of the barleys may be sown with every prospect of success; oats will probably fail one year in three.

In the small herd of dairy cattle one of the main problems studied has been abortion control. That a clean herd may be built up from one diseased has been amply demonstrated.

EXPERIMENTAL SUB-STATION, BEAVERLODGE, ALTA.

Developing from experiments voluntarily conducted in 1914, the experimental sub-station at Beaverlodge, Alta., some 100 miles north and 200 west of Edmonton, has in several phases attained almost the stature of a full-fledged station. It serves particularly a population of about 70,000 in the Peace and adjacent territory as well as that in the Athabaska watershed to the southeast and in the north-central portion of British Columbia to the west. It maintains touch, besides, with frontier outposts far down the Mackenzie, so that its field really covers the greater part of a drainage basin of 682,000 square miles—by far the largest area served by any branch station in Canada.

Commandingly situated on a ridge in the western part of the Grande Prairie district, amid a panorama of fertile country backed by snow-clad Rocky peaks southwest, it represents northern plateau agriculture and has naturally focussed upon pioneer problems.

Second cutting of alfalfa in the variety-test plots at the Beaverlodge sub-station. This variety, Ladak, yielded at the rate of 7,903 pounds of cured hay per acre for two cuts.

Early Varieties of Grain Needed

Feasibility of grain growing had been already demonstrated by settlers, but varieties were a vexed problem. Rather early ones are required. Selection, breeding and testing have been addressed to this end. A better early wheat than Garnet is sought. For farms needing an earlier oat than Banner or Victory, Legacy is recommended though new promising kinds are in prospect. Olli barley promises to be a real find, especially for the gray woodland soils, which are better adapted to produce malting barley than milling wheat. Flax and peas can be grown. Winter wheat is at times successful.

From the first, meadow crops have been featured because of their bearing upon animal husbandry and permanent agriculture. Alfalfa, regarded at first as a pipe dream, has been demonstrated a moderate success once effective inoculation is secured. A trail has been blazed in studying the inoculation problem,

especially good results on woodland soils being obtained with a strain of acid-tolerant nitro-culture developed at Rothamsted, England. The practice of taking but one cutting per annum without grazing the aftermath maintains vigour, resists weed encroachment and guards against winter injury.

Sweet clover promises to be the salvation of agriculture on the woodland soils. Large possibilities have been demonstrated in the production of grass and clover seeds. Brome is the best grass for general cropping and blends well with alfalfa or sweet clover.

Advantage has been taken of a unique opportunity for the study of micro-climatology. Between two points, 214 rods apart and 134 feet different in elevation, as much as 28 degrees (F.) spread in temperatures has been recorded on a given night. The foot of the slope has annually averaged between six and seven degrees lower in minimum than the crest of the ridge. Such records point to the economy of reserving dry hollows mainly for the production of hay and fodder, with residences, gardens and tender crops on the elevated slopes or on water-protected areas.

Fruits Do Well

Prodigious yields of small fruits have been frequently obtained, while 132 pounds of apples and crabs were produced in 1932. Home grounds may be planted with native material though results can be improved by employing some of the introduced species, such as roses, lilacs, honeysuckles, spireas and many others. The saskatoon has been trained into a fruitful and beautiful hedge.

Bees in the station apiary gathered 150 pounds of honey in 1935 and more than half a ton in 1936.

All classes of live stock have proved adapted, wintering well without closed stables.

Through printed reports, press articles, illuminated lectures, illustration stations, and personal contacts the sub-station has done much to further interest in higher ideals, better farming and better living conditions. Its influence has been stamped on the developing agriculture of the region.

EXPERIMENTAL SUB-STATION, FORT VERMILION, ALTA.

In 1908 the Dominion Government rented for experimental purposes five acres of river flat on the south side of the lower reaches of Peace river at a point seven miles west of Fort Vermilion (Lat. 58° 22′ N.; elevation about 860′ above sea level). The leasehold was from time to time increased until in 1935 it covered 35 acres. Arrangements were then made for the permanent establishment of the work on more representative land acquired by the government immediately west of Fort Vermilion. The sub-station serves a rather large area extending from Keg river in the southwest down to Vermilion Chutes on the east, and reaches back from both sides of the Peace for an approximate distance of 35 miles. The greater part of the area is parkland, with a gray, transition wooded soil, all of which is expected eventually to be brought under cultivation.

About 160 farmers are located within a radius of 35 miles from the Fort. Mixed farming is practised successfully; wheat, cattle and hogs constituting the greater part of the agricultural products. Most of these are sold to the local traders.

Twenty-nine years' data demonstrate impressively the cropping possibilities of the district even after due allowance is made for river-bottom situation and open-water protection from frost. Prelude, Reward, Garnet and Marquis wheat have regularly matured, although autumn frosts have occasionally lowered the grade. Complete crop failure from any cause has been unknown. In an eight-year test under direction of the Division of Chemistry, Marquis wheat yielded almost 50 per cent more at Fort Vermilion than at Ottawa, requiring but 3·4 days more time in which to mature.

Forage Crops Excel

Outstanding results have been obtained with forage crops, for the seasons are conducive to rank growth. Fodder corn has been known to outyield the plots on the highly fertilized land of the Central Experimental Farm at Ottawa. Plot yields of 40 tons green weight per acre have been obtained from sunflowers and field roots. Soybeans, although failing to mature, have yielded over eight tons of forage per acre.

Achievements with garden vegetables at the station and throughout the settlement have always astonished visitors. Corn, cucumber, pumpkin, squash and tomato succeed much better than on the elevated plateau of the Upper Peace.

Potatoes and staple vegetables yield abundantly.

Profusion of bloom is obtained from a wide range of annual, biennial and perennial flowers.

Currants and raspberries have yielded very well. Young plants propagated from the sub-station's original stocks and distributed to farmers have aided in the establishment of thrifty bush-fruit plantations.

These remarkable results have been obtained in a region where the 27-year mean annual temperature rules 27·06° F., where the recorded precipitation averages 11·71 inches and where the bright sunshine averages 2,091 hours per annum, ranging from 54 hours in December to 300 in July.

THE FAR NORTHERN SUB-STATIONS

Minor sub-stations in the Mackenzie District and the Yukon Territory have recorded official evidence of cropping possibilities at points popularly considered far beyond the northern bounds of Canadian agriculture. Vicissitudes admittedly attend cropping in these higher latitudes but the results achieved by enterprising cultivators in favoured spots, especially on elevated slopes facing open water, warrant further efforts to develop agriculture and horticulture subsidiary to the primary occupations of those regions.

All the sub-stations in the Mackenzie District have been conducted by the Oblate missions of the Roman Catholic Church. These had been previously gardening and in most cases farming for partial sustenance and have been paid a small annual sum to make simple tests and to report the results.

At Fort Smith (Lat. 60° N.) along the Slave river, the mission operates successfully on jackpine sand. To the westward at St. Bruno, some 20 miles out along the Salt river trail, it used to farm successfully. Fifty head of cattle were kept there in 1914 and 500 pounds of butter were sold.

Apples at Great Slave Lake

At Fort Resolution (Lat. 61° 10′ N.) on the south shore of Great Slave lake, seedling crab apple trees, planted about 1908, bore many crops of diminutive fruit until killed to the ground line in 1934-35, during a winter of scant snowfall. In 1933 a third tree, about two years transplanted, bore a pair of fruits an inch or so in diameter. Fort Resolution is 527 miles almost due north of Edmonton.

The Fort Providence mission (Lat. 61° 21′ N.) is situated on the north shore of the tapering western arm of Great Slave lake and has been gardening since shortly after the Sisters of Charity arrived in the year of Confederation. Ripe tomatoes and celery are no novelties. During five successive years the potato out-turn ranged from 5:1 up to 15:1 (i.e., 15 bushels crop per bushel of seed). A little field crop is raised, but there as at Resolution, the field cropping seems less successful than the gardening. The cattle are fed chiefly on wild hay.

In the Shadow of the Arctic

Close to the Arctic Circle is Fort Good Hope, perched on the high bank of the majestic Mackenzie river. On a small scale gardening has been carried on there for generations. In 1930 the Roman Catholic mission's potato yield was 393 bushels per acre. Plots of cereals seeded May 21 ripened well enough to be harvested, on the green side, on August 6 to 9, the latter date 80 days from planting. Edible wild fruits include the blueberry, pembina, cranberry, raspberry and gooseberry. Saskatoons grow on the Ramparts just above the post. Fort Good Hope is 1,183 miles above the 49th Parallel of Latitude.

Latitude considered, the gardens of the Yukon have been among the horticultural wonders of the world. At the Swede Creek sub-station (Lat. 64° 11′ N., Long. 140-06 W.) not only did garden vegetables do extremely well at times but alfalfa survived at least some winters and excellent grain yields were occasionally obtained.

Good Wheat Yields in the Yukon

In 1920 Marquis wheat plots yielded at the rate of 50 bushels per acre, while in the next year Ruby wheat yielded at the rate of 54 bushels. Very dry weather restricted production in 1922 yet Prelude wheat yielded 24½ bushels per acre and part of the wheat crop made flour said to be "far superior to the outside flour available on the local market."

From Carmacks, Y.T., variable results were reported for several years, 1932-34.